NOTE

This Microfiche meets the quality requirements of the American National Standard for Microfiche of Documents (ANSI PH5.9-1975). However, because of imperfections in the document from which it was made, it contains images that are illegible or difficult to read. The source document for this microfiche is the best copy that could be obtained prior to filming.

CIS Congressional Information Service Washington D.C.

TORNADO WARNINGS AND WEATHER SERVICE MODERNIZATION

HEARING

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FIRST CONGRESS

FIRST SESSION

AUGUST 7, 1989

[No. 48]

Printed for the use of the
Committee on Science, Space, and Technology

U.S. GOVERNMENT PRINTING OFFICE

21-905 WASHINGTON : 1989

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

H701-93

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

ROBERT A. ROE, New Jersey, *Chairman*

GEORGE E. BROWN, JR., California
JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
HAROLD L. VOLKMER, Missouri
HOWARD WOLPE, Michigan
BILL NELSON, Florida
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California
TIM VALENTINE, North Carolina
ROBERT G. TORRICELLI, New Jersey
RICK BOUCHER, Virginia
TERRY L. BRUCE, Illinois
RICHARD H. STALLINGS, Idaho
JAMES A. TRAFICANT, JR., Ohio
LEE H. HAMILTON, Indiana
HENRY J. NOWAK, New York
CARL C. PERKINS, Kentucky
TOM McMILLEN, Maryland
DAVID E. PRICE, North Carolina
DAVID R. NAGLE, Iowa
JIMMY HAYES, Louisiana
DAVID E. SKAGGS, Colorado
JERRY F. COSTELLO, Illinois
HARRY JOHNSTON, Florida
JOHN TANNER, Tennessee
GLEN BROWDER, Alabama

ROBERT S. WALKER, Pennsylvania*
F. JAMES SENSENBRENNER, JR., Wisconsin
CLAUDINE SCHNEIDER, Rhode Island
SHERWOOD L. BOEHLERT, New York
TOM LEWIS, Florida
DON RITTER, Pennsylvania
SID MORRISON, Washington
RON PACKARD, California
ROBERT C. SMITH, New Hampshire
PAUL B. HENRY, Michigan
HARRIS W. FAWELL, Illinois
D. FRENCH SLAUGHTER, JR., Virginia
LAMAR SMITH, Texas
JACK BUECHNER, Missouri
CONSTANCE A. MORELLA, Maryland
CHRISTOPHER SHAYS, Connecticut
DANA ROHRABACHER, California
STEVEN H. SCHIFF, New Mexico
TOM CAMPBELL, California

HAROLD P. HANSON, *Executive Director*
ROBERT C. KETCHAM, *General Counsel*
CAROLYN C. GREENFELD, *Chief Clerk*
DAVID D. CLEMENT, *Republican Chief of Staff*

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

JAMES H. SCHEUER, New York, *Chairman*

HENRY J. NOWAK, New York
JOHN TANNER, Tennessee
GEORGE E. BROWN, JR., California
HOWARD WOLPE, Michigan
DAVE McCURDY, Oklahoma
TIM VALENTINE, North Carolina
TOM McMILLEN, Maryland
DAVID E. PRICE, North Carolina
DAVID E. SKAGGS, Colorado

CLAUDINE SCHNEIDER, Rhode Island
SID MORRISON, Washington
CHRISTOPHER SHAYS, Connecticut
ROBERT C. SMITH, Texas
PAUL B. HENRY, Michigan
LAMAR SMITH, Texas

---

*Ranking Republican Member.

CONTENTS

WITNESSES

August 7, 1989: Page

Dr. Elbert W. "Joe" Friday, Jr., Director, National Weather Service, National Oceanic and Atmospheric Administration; Wayne A. Jones, Director, Greenville-Spartanburg Weather Service Office, National Weather Service 6

Lee Brown, WYFF-TV, Greenville, SC; John C. Roper, WSPA-TV, Spartanburg, SC; and Ken Bostic, WLOS-TV, Asheville, NC 46

James M. Miles, councilman, city of Greenville, SC; Shirley S. Hill, director of emergency preparedness, Spartanburg, SC; Michael B. Phillips, director of emergency preparedness, Greenville County, SC; Jimmy Wilkens, director of emergency preparedness, Union County, SC; and L. Wayne Broome, director, Charlotte-Mecklenburg Emergency Management Office, Charlotte, NC 64

Dr. Carlton W. Ulbrich, department of physics, Clemson University, Clemson, SC; Chris Reddick, manager, Delta Air Lines, Greenville-Spartanburg Airport, SC; and Larry Holcomb, airport operations manager, Greenville-Spartanburg Airport, SC 163

APPENDIX

Statement of William D. Evett, director, Pickens County Emergency Preparedness Department 175

Statement of Harvey A. Schmitt, president, Chamber of Commerce, Greenville, SC 177

Resolution of the South Carolina Emergency Preparedness Association, Victor C. Jones, president; Ernest L. Turner, president elect; Marybeth Solesbee, secretary; and Betty S. Polk, treasurer 179

Statement of Terrel L. Rhodes, chairperson, Emergency Preparedness Citizens' Advisory Committee, Mecklenburg County, NC 181

Statement of John C. Purvis, director, and David J. Smith, regional climatologist, Southeast Regional Climate Center, Columbia, SC 183

Strategic plan for the modernization and associated restructuring of the National Weather Service 222

TORNADO WARNINGS AND WEATHER SERVICE MODERNIZATION

MONDAY, AUGUST 7, 1989

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH, AND ENVIRONMENT,

Washington, DC.

The subcommittee met, pursuant to notice, at 9:30 a.m., in the auditorium, Tracy J. Gaines Learning Resources Center, Spartanburg Technical College, Spartanburg, SC, Hon. Tim Valentine and Hon. Elizabeth Patterson copresiding.

Present: Representatives Valentine, Patterson and Price.

Mr. VALENTINE. Ladies and gentlemen, we will get started, the hour having—the hands of the clock having faced in the right direction.

I am Tim Valentine, and I represent the Second District of North Carolina, and I will be presiding over this meeting of the subcommittee for a while, and then we will turn the gavel over to our distinguished colleague, Liz Patterson.

I am personally happy to be back in South Carolina. While I have lived in North Carolina, was raised, born and raised in eastern North Carolina, I spent part of my life in this state at the Citadel, that institution which some of you might be familiar with that is some distance from here in that city that will remain unnamed on the sea.

On behalf of the Subcommittee on Natural Resources, Agriculture Research, and Environment and its Chairman, the Honorable Jim Scheuer of New York who had a previous engagement and was not able to be here with us, I want to thank everyone who had a part in arranging this hearing, and everyone who has been a part of the fine welcome which we have received in this part of South Carolina in Liz Patterson's district.

The purpose of this morning's hearing is, first of all, to review the performance of the National Weather Service in providing warnings of the South Carolina tornadoes of May 5th, 1989. Secondly, to review the improvements in the timeliness of tornado warnings resulting from the implementation of new technology and modernization of the National Weather Services, and finally to assess the adequacy of NEXRAD coverage, particularly in the Greenville-Spartanburg area under the current Weather Service modernization plan.

To help the subcommittee fulfill its mission, we will hear today from the director of the National Weather Service, Dr. Joe Friday. We will also hear from local officials, from meteorologists and radar and aviation weather experts.

This subcommittee authorizes the funding for the National Oceanic and Atmospheric Administration, which includes the National Weather Service.

We have been urging the service to modernize its vintage equipment which is outdated, outmoded and in many cases unreliable and inoperative. The equipment currently in use is representative of the technology of the 1950s. Because of the public's increasing reliance on the Weather Service, it is essential that the service move as rapidly as possible to take advantage of improved forecasting capabilities as soon as this is practicable.

Much is still unknown about the tornado phenomenon in general, and in Southeastern tornadoes in particular. The situations which produce tornadoes in the East are entirely different from situations which promote tornadoes in the Plains and Midwestern states.

Congressman David Price arranged a hearing similar to this in his district, in Wake County some months ago, following the very severe tornadoes which struck central and eastern North Carolina I believe in November of last year. We were introduced for the first time—at least I was introduced for the first time to the fact that there is a difference between tornadoes which occur in the Plains states west of the Appalachians, west of the Mississippi River, and the same type of storm which occurs in our area, and we believe that there is a need to begin to learn more about the eastern cousin which we have all experienced up close recently.

Almost all of the federally-funded tornado research has gone into programs which are underway in Oklahoma, have been underway for many years at the University of Oklahoma. To study the other types of tornadoes, we are moving with the assistance of David Price, as I mentioned, and Liz Patterson to get funds to correct the situation, to commence research in the Southeastern part of the country to gain a better knowledge of the storms which affect us.

This morning I am pleased to be joined by two of our colleagues, Representative David Price, whose name I mentioned before, of the Fourth Congressional District of North Carolina, and Representative Liz Patterson of the Fourth Congressional District of South Carolina.

David Price is a leader in the Congress and especially in the field of education. Last week he introduced legislation which I have cosponsored which would establish programs within the National Science Foundation to promote scientific and technological literacy in the workplace. This legislation is very much needed as our work force prepares for the competition and technology changes of the next decade.

I will also commend our good friend Liz Patterson for her concern for the safety and well-being of not only her constituents, but all South Carolinians, as represented by her presence here today and her work in preparation for this hearing. She is without question one of the outstanding members of the House, and the people of this congressional district, and indeed the State of South Caroli-

na, are fortunate to have a woman of her caliber serving in Washington as a part of the House of Representatives. She and David have both won the respect and esteem of their colleagues.

I mentioned my connection with this state, and I say again that it is a pleasure for us to be here, and I will recognize at this time my colleague, David Price, for his opening statement.

Mr. PRICE. Thank you, Mr. Chairman. I want to add my word of thanks to Liz Patterson for hosting us here today as we bring the Natural Resources Subcommittee to South Carolina to learn about the storms that have occurred here, the kind of warning that was available, and beyond that, to explore what our capacities are going to be in the next generation to detect storms and to give an adequate warning.

I am pleased to be participating in this hearing, I commend Liz Patterson for asking the subcommittee to come to South Carolina. I also want to commend our subcommittee chairman, Jim Scheuer, for authorizing this hearing, and my colleague from the neighboring Second District of North Carolina, Tim Valentine, for presiding here today.

I know that Mr. Valentine shares my concern about the ability of the National Weather Service to detect hazardous weather and to issue timely warnings to affected areas. On March 3rd of this year this subcommittee convened a hearing in my district in North Carolina after a devastating tornado tore through nine North Carolina counties killing four people, injuring 157 others, and damaging hundreds of homes and businesses. The findings from that hearing were disturbing, to say the least.

While the Raleigh Forecast Office staff performed as well as they could have, given available resources, we learned that they were hamstrung by shortages in funding for personnel, by outdated technology, by missing parts. Everything went wrong, in short, that could have it seems at the time of that storm, and so virtually no warning was available to the affected areas.

Further documentation pointed to the failure of surrounding weather backup systems in Hatteras and Wilmington, North Carolina. Such failures unfortunately typify the deplorable conditions of our current radar system. Critical questions were raised about what improved detection and warning technology is under development and what it is going to take to get this equipment installed at key stations around the country.

The next generation Doppler radar, called NEXRAD, is currently under development, as we all know. There is good evidence that the Doppler radar will detect severe storms and tornadoes more quickly than our current system. In fact, NEXRAD may increase our present lead time of two to three minutes to 25 to 30 minutes, and that is an increase that could mean lives and adequate warnings could make a huge difference. This increased lead time could save hundreds of lives each year.

There are legitimate concerns about the geographic coverage for the NEXRAD system. We will discuss these concerns in more detail this morning. That is one of the prime focal points of this hearing. However, I believe the NEXRAD system will be far superior to the radar system now in place.

During markup of the National Weather Service reauthorization bill this year, the subcommittee at the urging of Representative Valentine and myself included language underscoring the critical need of implementing the NEXRAD system at the earliest possible date and discouraging any attempts to reprogram funds from the NEXRAD program budget, as has been done in previous years.

Unfortunately, overall fiscal constraints imposed by this year's budget agreement have limited the funding appropriated by the House for the NEXRAD system to a minimally adequate level—I would say not even minimally adequate, so I am very hopeful that this appropriations amount will be adjusted in the Senate and then in the conference committee between the two houses.

As Mr. Valentine has already mentioned, Eastern storm cells appear to be different from those found in the West and Midwest. They are smaller and often harder to detect. However, most of the research on tornadoes is conducted in the Midwest. It is clear we must develop the most advanced technology available to provide better storm warnings and to save lives. The underpinning of any technology is good research. We need to devote research efforts to severe thunderstorm and tornado activity unique to the Southeast. I am hopeful that with the inclusion of our Southeastern Storm Study amendment to the NOAA authorization bill we will greatly improve our ability to detect severe weather unique to our region.

Mr. Chairman, I welcome this hearing and look forward to the testimony of this excellent panel of witnesses.

Mr. VALENTINE. Ms. Patterson.

Ms. PATTERSON. Thank you, Mr. Valentine.

I am really grateful to Tim Valentine for bringing the Natural Resources Subcommittee to South Carolina and to the Fourth Congressional District, and for the fine work of the subcommittee, especially the staff, Curt Stanford who is with us today, and who has helped organize this hearing. I also want to thank the chairman of the Science, Space and Technology Committee, Mr. Roe, and the ranking member, Mr. Scheuer, for helping to set up this hearing.

Chairman Scheuer never hesitated when I went to him and told him that I wanted him to come, to hear and to hold a hearing in our district. I told him how important it was not just to the Fourth Congressional District, but to all of South Carolina.

I also want to thank my colleague from North Carolina, David Price, for being here today. With the help of Tim Valentine and David Price and the staff we were able to pull this hearing together.

Finally I want to thank Spartanburg Tech, Dr. Powers, for helping us to set up this meeting and for making your nice facility available to us.

As many of you in this audience know, I was prompted to request this hearing by the tornadoes that went through our area May 5th of this year. These tornadoes ripped through the Chesnee area causing 1.5 million dollars of damage and leaving two dead, and many more injured. I am concerned that the possible modernization plan of the National Weather Service will undercut the service now provided in the Greenville-Spartanburg area. Tornadoes of this sort are common to our region, and adequate weather

service coverage must be provided in order to help avert disasters in the future.

We are fortunate today to have a variety of excellent witnesses to help us accomplish our goals. Dr. Joe Friday, Director of the Weather Service, has been gracious enough to attend this hearing and to provide us with expert testimony on the weather service and the proposed modernization plan. We have several local experts as well who will provide us with testimony on the important issues before us. I thank all of you for taking time out of your busy schedule to attend the hearing, and I look forward to hearing the testimony.

At this time I would like for those persons who will not be speaking, but who will be presenting written testimony, representatives of counties, city governments, school districts, if you are here at this time if you will stand, one representative from each of those groups, and just identify yourself, which group you represent and your name I would appreciate it. Those who will not be testifying. I believe we have somebody from Greenville City. Yes, sir.

Mr. SMITH. David Smith, Southeastern Regional Climate Center, State Climatology Office, South Carolina.

Ms. PATTERSON. Thank you. Yes, ma'am.

Ms. BROCKINS. Candy Brockins, Office of Emergency Preparedness.

Ms. PATTERSON. Great. We realize it goes out of the Fourth District. Yes, sir.

Mr. RECTOR. David Rector, Pickins County Emergency Preparedness.

Ms. PATTERSON. Glad to have you.

Mr. BEAM. Joe Beam, City of Greenville Emergency Preparedness.

Ms. PATTERSON. Thank you, Joe.

Mr. ALEXANDER. M. O. Alexander, Greenville County Farm Bureau Board of Directors.

Ms. PATTERSON. And a member of the delegation from Greenville County. Yes, sir.

Mr. ANDERSON. Frank Anderson, Spartanburg Downtown Airport, Airport Manager.

Ms. PATTERSON. Thank you, Frank. Yes, sir.

Mr. CLEVELAND. Wade Cleveland, Greenville County Schools.

Ms. PATTERSON. By the way, if any of you all have a hard time seeing, I know we are set up at sort of a crazy angle, feel free to move.

Yes, sir.

Mr. JOHNS. Phil Johns, Spartanburg County Fire Chiefs Association.

Ms. PATTERSON. Thank you, Phil.

Mr. HOLDENS. Grady Holdens, Spartanburg County Schools.

Ms. PATTERSON. Thank you. I thank all of you for being here. Yes, ma'am.

A VOICE. We represent the amateur radio operators here in Greenville and Spartanburg.

Ms. PATTERSON. Very good. Thank you. I am sorry, I did not mean to miss——

Mr. WILLIAMSON. Virgil Williamson, Mayor, City of Union.

Ms. PATTERSON. We appreciate Union being here. Anybody else I have left out?

[No response.]

Ms. PATTERSON. If not, let me assure you that you may, anyone who wants to, submit a letter or any statement for the hearing. You may do it today, or you may submit it to our office before the first of September and we will enter it into the documents.

Anyone who came. Oh, I am sorry. Oh, excuse me. Mayor, Mr. Mayor.

The Mayor of the City of Chesnee is with us, so we appreciate you, Mr. Mayor.

Anyone else? I did not mean to leave anyone out.

Let me also say to you if there is anyone here who just needs to talk to someone from our congressional office, we do have some of my staff here if there are matters that concern you rather than the weather station. Rose, do you want to stand up so they will see you. Rose Pellett from my Spartanburg office is here, so if any of you have any other matters you need to discuss she is here.

Again, thank you, Mr. Chairman, for setting up this meeting and I will turn it back to you.

Mr. VALENTINE. You live and learn. I do not think David and I, when we had the hearing in his district, offered to do casework on that day, but that is a good idea. I compliment you on that.

We will proceed now—and thank you very much, Liz—we will proceed now with the first panel, and as we have mentioned before this consists of two distinguished gentlemen, Dr. Elbert W. "Joe" Friday, Jr., who is Director of the National Weather Service, and Mr. Wayne Jones who is Director, Greenville-Spartanburg Weather Service Office. Welcome. Your statements will appear in the record in toto, and you may summarize or otherwise proceed as you deem appropriate.

STATEMENTS OF DR. ELBERT W. "JOE" FRIDAY, JR., DIRECTOR, NATIONAL WEATHER SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION; WAYNE A. JONES, DIRECTOR, GREENVILLE-SPARTANBURG WEATHER SERVICE OFFICE, NATIONAL WEATHER SERVICE

Dr. FRIDAY. Thank you very much, Mr. Chairman. I am indeed pleased to be here before this subcommittee, and I am also very, very pleased to see the audience that we have represented here today.

We in the National Weather Service could do the best possible job of forecasting the weather, and I will not say that we do that all the time, but we could do the best possible job of forecasting the weather, but if it were not for the Emergency Management people, if it were not for the local law enforcement officials and so on, it would do very little good.

We also are very grateful for the amateur radio operators around the country that help us so much in spotting severe weather, in relaying critical information to us at that time. They indeed are the extension of our eyes and ears in order to be able to see out beyond what we can see with our equipment and where we may happen to be located, and certainly we appreciate that.

It is indeed a challenge to be here today facing as many of you with as many interests in the local office. It is not in one respect a very pleasant situation because I understand that you are all asking me to change our minds on exactly what we have planned for the future, but I think today what I would like to do is to outline a few things the way we are moving in the National Weather Service in the future, and I am going to let Mr. Wayne Jones outline the performance of the weather service office here during the devastating storms that had moved through here in the earlier part of the year.

I would first of all like to preface that to say that the performance of Mr. Jones and his staff has been absolutely amazing during this particular time. Both Mr. Valentine and Mr. Price pointed out the situation with our equipment and the problems that we have with our equipment around the countryside, and I will not deny that. That is one of the major reasons that we must move forward and modernize the weather service in the most effective manner and in the most rapid manner possible, so we will be discussing now today ways of doing that, and Mr. Jones will be discussing the performance of the local office during the recent storms.

In March of 1989 Secretary Mosbacher, the Secretary of Commerce, transmitted to Congress to the president's plan for the modernization and restructuring of the National Weather Service. Implementation of this plan will significantly improve the services provided by the National Weather Service with respect to exactly the type of storm that moved through this area earlier this year. The plan calls for taking advantage of the technological developments and scientific developments over the past two decades in the better understanding of small-scale weather phenomena, in the severe storms, in the flooding situations that occur, and particularly have occurred in a devastating fashion this year in the Southeastern part of the United States.

I was raised in Oklahoma, so I will not say that is the reason that we do all the research there, but I was raised in the middle part of the country, and so I am familiar with tornado alley and the activities that we have had there. But the storms that we have had moving through this part of the country this year have been particularly devastating, and it seems like tornado alley may have moved over a little bit in the past few years. So we certainly do recognize the severity of those storms.

We intend to place this new technology in around the country in a manner that we feel accurately and adequately represents coverage for the country, and I will discuss this a little more a little later on. We are talking about modernizing the weather service in the observational tools that we use to detect weather events, and in the processing capability that we use in our offices to be able to analyze and forecast the weather situation.

The observational tools are the better ways that we will go about seeing the weather, both at the local airports with the automated surface observing equipment that will be replacing equipment that in some cases predates the Korean War. The new radar system that Mr. Price and Mr. Valentine both spoke of a few moments ago, the Next Generation Weather Radar, will be replacing radars that have the designation WSR-57. WSR stands for Weather Serv-

ice Radar; 57 is the year of design. That is 1957. They are quite old, and they are in need of replacement. Even some of the newer radars that we have are also showing great signs of wear. They are already over 15 years old and are beginning to cause us a great deal of problems with maintenance, and if it were not for people that we have in our local offices that are really highly capable and highly motivated to maintain this equipment, we would be in worse shape than we are now. And I just extend that recognition to our electronic maintenance, electronic technician personnel that we have around the nation. Mr. Jenkins here, and Ms. Brown here at the local office have done a fantastic job of maintaining the local equipment, and for that we are thankful.

The situation that we have then is to replace the observing equipment with ASOS for the ground, NEXRAD for the radar system, and also to replace the satellites that are currently providing the overview of the entire United States. The satellite program is—as some of you may be aware—we only have one operational weather satellite at the present time. Prior to half a year ago we had two satellites, one positioned slightly over the East coast of the country, one positioned slightly out over the West coast so that we provided a good look out into the Atlantic for the hurricanes and a good look out into the Pacific for the winter storms moving in. Also there are a few people out in Hawaii and Alaska that like for us to cover those areas with satellites occasionally, so we have those situations.

At the present time we are down to one spacecraft, and it is centered at present time over the middle of the country. It moves slightly to the east during the summer time to cover the hurricanes, it moves slightly to the west during the winter time to cover the winter storms. The new satellite system will be launched in early 1991, and we will then be able to go back to the dual satellite coverage.

But in addition to being able to better observe the weather with ASOS and NEXRAD and the satellite program, we must also be able to better analyze the weather and to be able to bring all of this information together and use it to be able to adequately forecast and to provide the warnings that are so necessary.

There are two programs that we have in the modernization plan of the weather service that are aimed at this. One is improving the computer capability of our national center in Washington, D.C. that brings together the worldwide data base—that is the sort of system that provides you with information on what it is going to do tomorrow and the next day, and perhaps the next week. It provides the aviation community with the necessary winds and weather conditions on which to plan flights and to operate the flight schedules across the United States, and indeed across the world. It provides the information to all of the local offices to alert them to what is going on over the next day or so, and beyond, so that they can concentrate on the immediate happenings over the next 12 to 24 hours.

And then finally we will be replacing the local computer equipment, the local work station equipment that is in the local offices. I do not know how many of you have visited Wayne's office out here at the airport. The computer equipment that he uses there has less

capability than what many of you may be using with an IBM PC on your desk. It serves us well—as a matter of fact, we were one of the first users of this type of equipment in an interactive fashion to be able to provide assistance to making the warnings and forecasts, but the fact is, that is 1972 technology, and most of you are aware of the advances that computers have made over the past 17 years. So we will be replacing these systems with a system called the Advanced Weather Interactive Processing System. Unfortunately in the federal government everything has to have an acronym, and that is ours there with the AWIP System to replace that, and that will provide the offices around the country with the ability to bring all of the data together to use and analyze it, and then to provide the warnings and forecasts necessary to provide the services to the country.

With the new technology then comes an opportunity to look at the organizational structure of the weather service and to try to decide the best possible structure and the most economical structure. Mr. Valentine I believe, or Mr. Price one, referred to the fiscal pressures that we are all faced with, and indeed we are all faced with that in the federal government. I am personally faced with it at home as well, and I am sure many of you are. And it is a matter then of trying to take a look at the entire program across the country to try to balance out the service delivery capabilities, the improvements in products and forecasts that we expect to have, and the total overall cost. So we have structured and provided to the Congress in our strategic plan an organizational structure which will have 115 weather offices; weather forecast offices uniformly positioned across the country.

The office structure that we have today is nonuniform. It is most heavily located in the Eastern part of the United States where this country was first settled, and it goes to a very sparse distribution of stations out in the Western part of the United States.

The weather bureau, the Weather Service began over 120 years ago, and we still have some offices that date back that far. That is not saying they are bad offices, it is saying that when we positioned those offices across the country we were basing those office distributions on different technologies, different capabilities than we have today, so one of the things that we did during the creation of the modernization plan was to look at the total overall requirement for providing a good, uniform service delivery across the country.

Now, there are concerns that the office structure we have is not sufficient. There are several things that I wish to reemphasize here. First of all, every office where we, every location where we currently have a weather office will continue to have weather observations taken at the airport, will continue to provide the necessary observations to support aviation and to support the local community and to continue the historical record. That is the ASOS system, and those systems have been tested now for the last two and a half years throughout the state of Kansas under a wide variety of weather events, under a wide variety of situations, and have proven to be very successful. Those will be delivered across the country beginning in 1991 and ending in about 1994.

The radar system as I have indicated will be available to cover completely the Eastern part of the country, and I will describe the coverage question in a moment that Mr. Price raised. The satellite of course will cover the entire country.

We have the public law that was passed last year at the behest of this committee. As a matter of fact this committee is very concerned about the modernization of the weather service, and I appreciate that. I have enjoyed working with the committee over the past several years as we have moved forward in this area.

The public law that is now on the books requires that the National Weather Service, before it closes or consolidates or automates or relocates any office—and I think they chose those words because that took into consideration all possible things that we could do—that before we do any of those things which might adversely affect services to a community the Secretary of Commerce personally must certify that those actions will not degrade services to the communities involved. He must certify not only by signing a piece of paper, but he must also have available to him and to you as well documented evidence of all of the tests and evaluations and results of those tests that show that that service will not be decreased, will not be diminished. It is only after then could we possibly even consider closing a station such as the one here.

You will be witnesses of that and, as a matter of fact the review, the evaluations, the certification process is being designed so that I do not do it, I do not actually put this piece of paper together and say that we are not decreasing services because quite frankly you may not trust me in doing an objective job of it. It will be done by an outside agent, an outside evaluation group. It will be reviewed by—if the plans go as we are currently envisioning—a panel of the National Academy of Sciences and Engineering in Washington, a very objective body for those of who are familiar with their work. They will review the evaluation techniques, they will review the results of the evaluation, and they will provide that information to the Secretary of Commerce through me to say whether or not we have satisfied the needs of the community before we do any consolidation or closures. A very, very objective, a very critical process to make sure that we do not take shortcuts in this area. Our job is not to reduce services to anyone in this country. Our job is to improve services, improve our capabilities of providing warnings and forecasts to the population of this nation.

Each one of the segments represented in this room that Ms. Patterson surveyed a few moments ago will be involved in that certification, because we have to have inputs from you. We have to have inputs from the local city and state governments, we have to have inputs from the local emergency management agencies, we have to have inputs from the local media outlets to make sure that they will receive the sort of support. We in the weather service do not do a very effective job of communicating directly to the public. We do a very effective job of communicating with the media, and they are the ones that communicate to the public. Most of you receive your weather warnings and forecasts directly from one of the radio or television stations in the area, as well as an all-weather radio, but we depend very heavily on the media to make sure that we get the information out to the public to alert everyone to the hazards

of weather. We will continue to do that in the future, and we have to make sure that as we restructure the weather service across the country that all of the connections that exist how and have developed over the last many, many years continue to exist in the new structure, that each one of the emergency management offices across the country know where weather information is originating and how they get it, and to make sure that is working very effectively. All of that has to be done before we do anything about restructuring an organization.

With respect to timing, we clearly cannot start to close a weather station before the new technology is in. We simply cannot do that because otherwise we would never be able to provide that continuity of services, and that is one of our biggest challenges. It is not like an automobile manufacturer where we can shut down for a few weeks in the summer time and convert over to a new line of cars. We have to be able as we are bringing in all of the new technology, all of the new equipment around the country, we have to be able to continue to provide services during this entire transition, and to make sure that we do not adversely affect those services during that time period.

It is a major opportunity that we have in this nation to move forward with significantly improved services. The work that we have done so far in Oklahoma and in Colorado have shown that we can significantly improve the accuracy of our warnings.

And the question of range of radars comes up. I will be very straightforward with you here. There is no such thing as a fixed range for any radar unit. The closer you are to the radar the smaller—until you are in the ground clutter for those of you who have seen the ground clutter patterns around some of the sites—the better you can see smaller scale features. The further you are from the radar, the more difficult it is to see smaller scale features. That is simply because the radar beam is a geometric quantity with a certain width to it, a certain angular width to it, and as you go further away that beam spreads out and is not able to detect as small an area as it could closer in.

An average size tornado, whatever that might be, we could expect to see with NEXRAD somewhere on the order of 50, maybe 60 miles away from the radar. You are not 60 miles away from the nearest radar here; you are about 85 to 95 miles away from the nearest radar in the future plans.

A smaller tornado you will not even be able to see at 50 miles. A larger tornado you may be able to see at 85 miles. But the point is if we depended on actually seeing the tornado with the NEXRAD to issue a warning or a forecast it would be too late. What we have done over the past two decades is we have learned more and more about the actual storm structure, the actual storm development and morphology. We have learned more and more about the factors in the storm and in the surrounding atmosphere that causes the growth and development of those storms, so that we do not have to actually detect a tornado to be able to forecast it. We can detect the storm structure and the capabilities there, and that is the way that we obtained the increased warning times and lead times in the tests that we have already conducted in the states of Oklahoma

and Colorado with the research radars that we have been using there.

We will be expanding those sorts of capabilities to other parts of the country as we start to move around, and it is clear the techniques that we have learned in Oklahoma will not be directly transportable to the Carolinas. There are different parameters controlling the storms here, and as we begin putting in the radars in the new parts of the country one of the first things that we will be doing is working with those radars locally to adjust the computer algorithms, the computer programs that help us identify the storm structure and the storm motion, and we will be making those changes in the first year of operation so that we will be conducting essentially research and development with every new installation that goes in and moving across the country with those, so it is a continuous learning experience.

With regard to any schedules, first of all let me perhaps ease your mind in the fact that we have no intention of closing the local office here within the next several years. The radars that will be covering this part of the country will not be going in before early 1993, late 1992 or early 1993. There could be no possible office closure here prior to that time, so there is no intention of closing the local weather office within the next year or two as had been rumored as soon as the plan went out.

Now, your colleagues here on the stage and my friends on the committee have also included in the law a requirement that we tell you exactly what we are doing at every stage of the game, and I applaud that. I think we should do that.

In October of this year I have to provide this committee with a detailed national implementation plan that outlines the timetable for all of our actions across the country and goes into detail on what we expect to do in the next three years, so as soon as that becomes available, and it is not yet completed—as a matter of fact I have one of the early drafts in my briefcase here that I am trying to do a little work on during this trip—as soon as that becomes completed then the exact schedule of events will be laid out, and then every year that will be updated so that every year you will see then in more detail the next year's activities, so we will continue to have this well laid out, well vocalized on exactly the processes that we are going to go through.

Mr. Chairman, members of the committee, it is indeed as I said a pleasure to be here. I think this is one of the most exciting times for the field of meteorology over the next several years, and I hope that by 1995 we might be meeting again after the modernization of the National Weather Service is completed, and really taking a great deal of pleasure in looking at the advances that we have been able to make.

Thank you very much, sir.

[The prepared statement of Dr. Friday follows:]

Statement
of
Dr. Elbert W. Friday, Jr.
Assistant Administrator for Weather Services
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

before the

Subcommittee on Natural Resources, Agriculture
Research, and Environment
Committee on Science, Space, and Technology
House of Representatives

August 7, 1989

Mr. Chairman and Members of the Subcommittee:

I am pleased to appear before you on behalf of the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce, to discuss tornado warnings and the President's Strategic Plan for the Modernization and Associated Restructuring of the National Weather Service (NWS).

In March 1989, Secretary Mosbacher transmitted to the Congress the President's Plan. Implementation of this Plan will significantly improve the services provided by NWS with respect to exactly the type of severe weather which occurred in upstate South Carolina on May 5, 1989. The Plan calls for putting recently developed meterological science into practice through the training of NWS personnel and the deployment of proven, new observational, information processing, and communications technologies. By reliably automating the operation of our existing radar systems, our personnel will then be able to concentrate on analyzing, predicting, and issuing timely warnings

of severe weather. By providing them with integrated data from our radar systems and from new observational systems, we can expect substantial improvements.

The new observing systems planned include the Automated Surface Observing System (ASOS), Next Generation Weather Radar (NEXRAD), and advanced weather satellites. ASOS will provide continuous uniform surface observations and will allow forecasters to monitor significant weather changes immediately.

NEXRAD coverage will blanket the entire Nation East of the Rockies and provide significantly improved coverage in the intermountain west. This coverage represent a significant advancement in our ability to observe local atmospheric process. Unlike current radars which can only detect water droplets within clouds, NEXRAD will identify characteristic motion patterns in and around severe thunderstorms and provide valuable information into atmospheric processes before damaging weather occurs. This, coupled with an improved understanding of atmospheric processes, will increase the leadtime and accuracy of tornado, severe thunderstorm and flash flood warnings.

Advanced weather satellites will identify, observe, and track both large-scale weather systems and small scale local severe storms. This will include winter storms producing freezing precipitation and snow, hurricanes moving northward along the Atlantic coast, and tornado producing thunderstorms. When combined with the other new observing technology we expect a

significant improvement in our ability to issue timely warnings regarding severe weather.

Centralized computers at the Numerical Meteorological Center (NMC) analyze and provide predictions of the atmosphere on a global scale. The guidance provided from these predictions is essential to local forecasts beyond twelve hours. In the future, NMC will receive new Class VII computers. The new computers will increase the resolution and accuracy of the global predictions and will also improve the local guidance.

The Advanced Weather Interactive Processing System (AWIPS) will be the local processing system which assists the forecaster with warnings and forecasts through communications, data collection, data analysis, graphic displays, improved forecast techniques, and dissemination of products. Through automation of labor intensive forecasting processes, AWIPS will provide the professional forecaster with more time to concentrate on the warning and forecast problem. AWIPS will provide the forecaster with integrated NEXRAD, ASOS, and weather satellite data. This integration of data sets is one factor that will enable NWS to improve warning and forecast services.

Weather Forecast Offices (WFO's), in general, will be located near NEXRAD sites, and will be staffed largely with professionals. The uniform warning services over the WFO's area of responsibility will be ensured by providing the forecasters with access to the NEXRAD data for that area. The professional

staff will have the knowledge, skills, and ability to take advantage of the volume and variety of observational data which will be available to them in the future.

Deployment of the NEXRAD network plus the ASOS network and advanced weather satellites will represent a significant advancement in the hydrometeorological sciences because of our new ability to observe local atmospheric processes. To take full advantage of this advancement, NWS professional employees will be trained to understand and use the information which will be available to them. Part of this training will deal with the new systems such as NEXRAD and AWIPS, and a part will deal with professional development in the understanding of the scientific advances in research meteorology.

When completed, the modernization and associated restructuring of the NWS will result in improved warning and forecast services for the Nation. The modernization includes new advanced observing systems, advanced local processing equipment, and new high speed centralized computers. Restructuring involves the realignment of NWS field offices so that uniform weather services will be provided across the Nation. It also involves increasing the professional level of these offices so that we can take advantage of the information available from the new observing systems.

Now I would like to discuss the events of Friday, May 5, 1989, when severe thunderstorms swept across northwestern South Carolina. Between 5:15 pm and 5:45 pm, thunderstorms with at least three tornadoes struck that area. The most serious tornado occurred at Chesnee, South Carolina, at about 6:30 pm killing two people and injuring 35. The resultant damage was estimated at about $2.5 million dollars. Further to the west, two weaker tornadoes occurred in Oconee County between 5:15 pm and 5:45 pm. There were no deaths or injuries and only minor property damage was reported.

On May 5, from 2:45 pm until 9:00 pm, northwestern South Carolina was under Tornado Watch 183, which was issued by the National Severe Storms Forecast Center in Kansas City, Missouri. Eleven tornado or severe thunderstorm warnings were issued by the Greenville-Spartanburg National Weather Service Office (WSO) between 5:21 pm and 6:36 pm. Nine of these warnings verified with lead-times of up to 36 minutes before damaging weather occurred. This was an outstanding effort that reflects both the truly excellent severe weather warning program that exists at the WSO and the capability of the office's meteorological technicians to respond to the extraordinary weather events of that day.

However, the warning effort was hampered by the lack of timely radar and satellite information. WSO Greenville-Spartanburg receives radar information via a telephone line from the WSO Athens, Georgia WSR-57 radar unit. During periods of

severe weather, as much as 20 minutes can elapse between updates of radar information. On May 5, 1989, warnings were primarily based on extrapolation of the severe weather's past history.

Operations at many WSO's across the Nation are hampered today by old technology or the lack of access to satellite data. Our science and technology have moved ahead. The single purpose radar operator, data interpreter, or even radar display is inefficient and does not provide complete data or the processing capability needed to fully utilize today's data. Implementation of the President's Plan will provide our forecasters with integrated displays of surface reports, high resolution satellite imagery, NEXRAD data, and vertical sounding data complimented with advanced processing capabilities. These complex data sets will reveal the local dynamics, the inner workings, of local severe weather systems. Well-trained scientists using these tools will be capable of much earlier detection and even prediction of the severe thunderstorms and tornadoes. The changes which support better warning services to the nation will also allow our Agency to function more efficiently and our forecasters to become better scientists.

The chart, which I would like included in the record as part of my prepared statement, indicates the planned NEXRAD sites in South Carolina and adjacent States, and delineates the area of coverage which each radar will provide. Radar range is difficult to quantify. It depends, in part, on varying atmospheric

conditions and terrain. Based on experience with Doppler radar at Norman, Oklahoma, we expect to see improvements in radar detection out to a distance of 230 kilometers or about 140 statute miles. Spartanburg and Greenville lie about 84 miles and 97 miles, respectively, from the Columbus NEXRAD sites - well within the established range for severe thunderstorm detection and rainfall estimations. Mesocyclones, the circulating winds from which tornadoes typically form, will also be detectable at this distance.

The NEXRAD system is designed to ascertain a thunderstorm's dynamic characteristics, such as the direction and velocity of its internal winds, which create the potential for tornado formation. The detection range of the actual tornado vortex varies with the diameter of the vortex. The detection range for an average size tornado is about 65 miles. However, since the thunderstorm systems which produce them extend up into the atmosphere well above 10,000 ft, NEXRAD will be an effective tool in their prediction out to its full range.

Although any radar's performance gradually decreases with distance, the performance of NEXRAD will be considerably superior to that of the existing radar in Athens, Georgia, in that its velocity information will extend out to 230 kilometers and reflectivity data will extend out to 460 kilometers. With a fully deployed NEXRAD network, all communities in upstate South Carolina can expect substantially improved weather radar

coverage. However, it is important to emphasize again that in future NWS operations, it will be the integration of NEXRAD data with automated surface observations and advanced satellite data which will result in the most significant improvement in forecast and warning services.

The process by which the NWS will comply with the certification requirements of section 408 of Public Law 100-685 is in three parts; notification of future modernization and associated restructuring significant events, notification of intent to certify, and certification.

Each year the Secretary of Commerce will submit the National Weather Service National Implementation Plan for the following three years to the Congress. This Plan will include a list of significant MAR events that are to occur during the following year for areas that will be affected by future NWS office closures, consolidations, automation, or relocation. Significant events, which must occur so NWS can achieve modernization and associated restructuring, include changes in facility; staff at local offices; operations and services; relocation and decommissioning of old technology; and the commissioning of new technology. This notification is intended to keep the Congress and users of weather services informed in advance of all future significant changes to NWS operations.

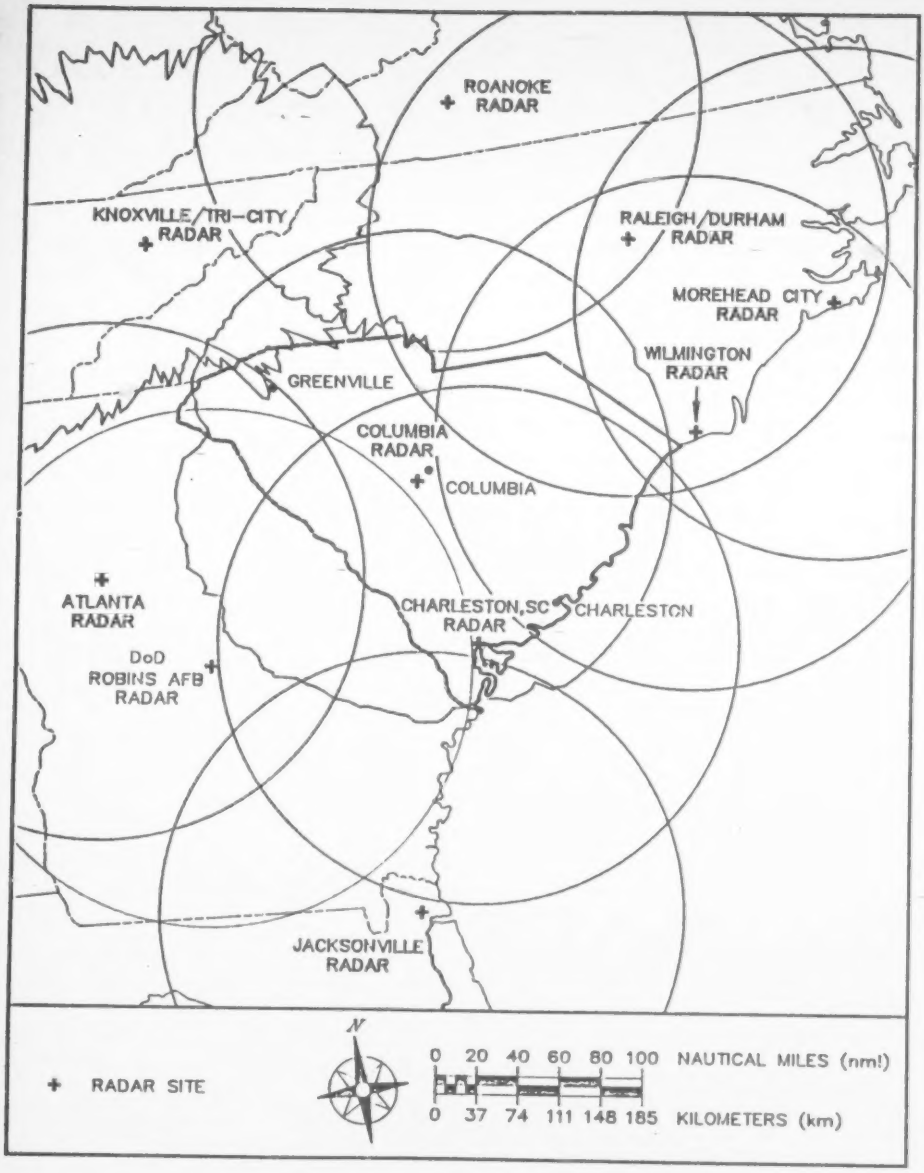
Each year when the National Implementation Plan is submitted to Congress, it will also include notification of which offices it intends to certify during the following year. A detailed comparison of the services provided to the affected area before and after office closure, consolidation, automation, or relocation; plus, any recent or expected modernization of NWS operations which will enhance services in the affected area, will be included in the Site Implementation Plans which cover the affected area. Evidence, based upon operational demonstration of modernized NWS operations, which support the conclusion that no degradation in services will result from office closure, consolidation, automation, or relocations will be included as part of each demonstration's documentation. Notification to the Congress of each NWS demonstration will be through the National Implementation Plan.

Finally, when all the necessary steps have been completed for closure, consolidation, automation, or relocation of a WSO, a certification statement will be prepared by the NWS Region responsible for that office. The statement will be endorsed by NWS Headquarters and the Secretary of Commerce, and then delivered to Congress.

The modernization and associated restructuring of the NWS will represent a major transition from today's operations to those of the future. The NWS will make every effort to ensure

that quality service remains constant during this transition. We are looking forward to working with the Congress as described in Public Law 100-685 to ensure that modernization of the NWS is a success.

Mr. Chairman, this concludes my prepared statement. I will be glad to answer any questions you may have.



NEXRAD COVERAGE OF SOUTH CAROLINA AT 10,000 ft

Mr. VALENTINE. Thank you, Dr. Friday.

Mr. Jones.

Mr. JONES. Thank you, Mr. Chairman.

It is a pleasure for me to be here today also, of course, and I look out in the audience and I see many of the people I work with every day, and I appreciate your attendance today.

I am going to discuss primarily the activities of our office on the May 5th outbreak, but first I will go into a little background.

Our office has had traditionally a very fine and experienced and capable staff, and I was honored when I learned I would join them in April of 1988, and I have learned much from them even since I came here, and I am proud to be a part of the Greenville-Spartanburg office of the Weather Service.

When I got here I saw two immediate needs, and I kind of focused my activities along those needs as I saw fit.

The upstate in South Carolina has experienced very mild weather for about 15 years, or had until this year. Back in the early and mid seventies we had a number of tornado outbreaks and a lot of flash flooding and a lot of severe weather in general, and although we had seen an increase in the number of severe storms during the 1980s they were mostly small-scale wind events and hail events, and not the very damaging types of weather that we had earlier, and I sensed a need in the upstate to re-educate the people and the media and the emergency preparedness people that certainly we could have very damaging weather, and so during the summer and fall last year I focused most of my talks and most of my presentations along those lines, and I am kind of glad we did because we have had a very rough year as you know.

The previous person in my position at the office initiated a very strong spotter network, and that has certainly paid tremendous dividends for the upstate, and I also work with spotters a lot, and we depend heavily on them, and we have been adding to those numbers as we have moved along with our progress of re-educating the upstate so to speak.

The year of 1973 was particularly bad. We had several major tornado outbreaks that year. I believe we had one in March, we had one on Memorial Day weekend which I believe struck Spartanburg County, and we had another tornado outbreak in December of that year, and it appears to me that 1989 has been the most active year since 1973.

We serve ten counties in the upstate, and they are fairly densely populated. For the most part our ten-county area has escaped the outbreaks of very damaging tornadoes which have been occurring with somewhat increasing frequency across the Southeast United States.

I can remember the March 28th, 1984 outbreak particularly well in North Carolina because I worked radar at Raleigh that night and, of course, Raleigh also experienced a very damaging tornado in November, and there have been several other outbreaks in Alabama and Georgia, but for the most part the upstate had escaped those until this year, and then we shared in the devastation of a very damaging tornado.

The second major effort I was involved in, I have always—I have had about 20 years of severe weather experience, and some of my

early years were under the direction of some of the pioneers in the severe weather business, and they taught me one thing, and that can be summed up in when you learn something about a storm you pass that information along as quickly as possible to the public, and that is one of the things we can do best at the local office and from a local level, and so I focused our activity at the local level around that thought, and so I have tried to develop and have a very aggressive approach to severe weather operations. I believe in communicating to the local officials very quickly and tell them exactly what I know about storms, and that is the kind of approach we have tried to have at Greenville-Spartanburg.

So far this year at the office we have been very fortunate, we have had a predictable kind of severe weather for the most part. During much of the eighties we have had storms which developed within 15 minutes, produced their weather for about ten or fifteen minutes and then fall apart. Those storms are very, very difficult to warn for, because you only have a few minutes to detect a storm and get out the warning before they strike.

This year much of our severe weather has resulted from major systems moving across the upstate, and in those kinds of situations we are able to provide more warning sometimes, and so far this year we have issued warnings for about four out of five storms that have moved across, severe storms, and we have confirmed seven tornadoes in the upstate this year, and we have been fortunate to have warnings for six of those tornadoes while the storm was on the ground with some amount of lead time, so we have been very fortunate in that sense. And this is an excellent record, we are very proud of it. I told Dr. Friday yesterday that we are competing with some of the best offices in the country, and we are very proud of that record.

But again many of our storms, and most of our storms in the Southeast are not that detectable. We do not have the skill in many cases to identify storms very far ahead and get warnings out.

Before the May 5th outbreak, the day before as a matter of fact, we recognized the potential for severe weather, and we adjusted staffing at our office. I was scheduled to work a regular administrative shift, but in order to have double coverage during the severe weather I rescheduled myself to come in at four o'clock in the afternoon, so we had two people on duty at the same time from eight o'clock in the morning all the way until midnight. That is what we scheduled at least. So we did see the severe weather coming in a sense in the form of outlooks of severe storms from our Severe Storms Forecast Center in Kansas City.

Early on Friday the staff noticed that the threat of severe weather became much more clear during the day. A small intense low pressure center developed near Atlanta early in the afternoon and was poised to move toward the upstate, and at around 2:20 in the afternoon the Severe Storms Forecast Center in Kansas City issued a tornado watch until nine o'clock that evening.

Starting at about 2:30 our staff began to swing into a more active severe weather mode. We started issuing more statements, talking about the possibility of severe storms and tornadoes in the upstate, and then the staff followed the severe thunderstorm activity as it developed in Georgia and moved toward our area.

Our statements on weather radio for an example were revised to highlight the threat of severe weather, and we also inserted tornado safety rules into the programming.

At 2:45 and 3:45 our office wrote statements that indicated that severe thunderstorms would be possible later in the afternoon and evening, and mentioned that the activity currently in Georgia could move into the area.

And then at shift change time, which is four o'clock, we decided that two people would not be enough to handle the severe weather, and so we decided to keep another person over, and so we worked the severe weather event with three people.

Starting at about 4:20 we started calling the emergency preparedness directors in the counties in the upstate, first in the western part of the area and then in the eastern part of the upstate, so that the weather would follow in the sequence we called. We needed to get the word to Anderson, Oconee and Pickens Counties right away, of course.

And that is not something we would routinely do. We did that on the April 4th outbreak as well. We sensed in both cases that it was an extremely urgent situation and that people needed to be prepared for it.

Then at 4:33 the Severe Storms Forecast Center issued a second watch for the upstate, and it included what they called the enhanced wording option. It had the phrase in there "This is a particularly dangerous situation." That information was broadcast directly to the public through the media and over NOAA weather radio, and when they do that they mean that they have identified the case as a worst case type of tornado outbreak with the possibility of the damaging types of tornadoes that were to follow.

At 4:35 we issued a statement describing the line of severe storms in Georgia. We talked about the warnings that were being issued in Georgia, and then we projected an arrival in the upstate of between five o'clock and six o'clock, and at 5:15 we wrote another statement to confirm that all counties in the upstate were indeed under a tornado watch, and we projected severe storms into Anderson, Abbeville and Greenwood counties by 5:45.

During this time the spotter reports in Georgia were indicating that severe thunderstorms were occurring ahead of the main line of storms. This is the type of thing we look for in tornadic storms, and it gives us a clue that this is something more than your usual severe weather outbreak. Our radar imagery that we get from Athens, Georgia was quite poor, however, and we were not able to well correlate the reports we were getting with the images we had available. At times we had delays of 20 or more minutes between updates on our radar system, but we were able to judge the approximate speed and direction of the movement of the severe storms.

At 5:19 the weather office in Athens, Georgia gave us a phone call and said that there had been a possible tornado in the Toccoa area, which is just across the border from Oconee County, so at 5:21 we issued a tornado warning for southern Oconee and Anderson County, and then at 5:23 Oconee County reported a tornado near Westminster.

Then at 5:24 we issued a tornado warning for Pickens County based on that report, and we issued a severe thunderstorm warning

for Abbeville County at 5:36 because there were so many reports of wind damage and hail over in Georgia.

Then at 5:51 we issued a tornado warning for Greenville County because we could not determine that there was any less threat for Greenville County than Pickens County. This was during one of the periods in which an update was not available to our radar system, and we felt with the magnitudes of the storms that we should issue a warning for Greenville County, and Kansas City had called our Columbia office and had advised that this was indeed a very dangerous situation, and Columbia passed that information along to us, and so we felt the need for the warning for Greenville County.

Because of the radar problems we were not able to see that this cell that was tornadic ahead of the line of thunderstorms was accelerating out ahead of the line as quickly as it was.

At 6:01 we issued severe thunderstorm warnings for Greenwood and Laurens Counties. The storm seemed to be affecting those areas, so we issued severe thunderstorm warnings there.

And then starting at about 6:15 we received several reports simultaneously almost of tornadoes and funnel clouds near Boiling Springs, and during the storm survey the next day and in the following couple of weeks I found several people who described the funnel cloud to as it moved across. In fact, there was one report of the funnel could as it moved across northern Greenville County, a giant twin funnel was reported. Unfortunately, we did not get that report until the next day. If we had received that report real time it would have been very valuable.

We were in the process of issuing a severe thunderstorm warning for Spartanburg County and Laurens County, and we simply changed it to a tornado warning at 6:18, and it went out on the wire. We included Laurens County because there had been a report of severe damage in Anderson County, and the radar image did not appear any less threatening for Laurens County than it did for Spartanburg County.

Then at 6:36 we issued severe thunderstorm warnings for Union and Cherokee Counties based primarily on the consistent damage reports coming into our office from our fine spotter network.

As best we could determine the Chesnee tornado caused major damage in the state of South Carolina starting at about 6:20 until 6:35 when it crossed the border into North Carolina. We classified the storm as a F-4 storm, meaning the winds were well in excess of 200 miles an hour in some spots, and it was about a mile wide at some points, so this is one of the major devastating types of tornadoes that I mentioned earlier.

Some of the people I talked to in the Chesnee area recalled hearing the warning before the storm got there; some did not hear the warning but they saw the storm coming. I have not talked to anyone who was not aware of the storm by some means as it approached, although I am sure there are some.

I believe the low death rate in the Chesnee area was the result of years of education, and that is one thing that has become clear to me in the last year or two that this message that we have been preaching for years, tornado education and safety rules have been

hitting home apparently. People are responding when warnings are issued, and that is very good.

Following all three of the major severe weather outbreaks this year many people I have talked to and have read about have described taking the actions as they heard the warnings, and this is really something that makes us feel good when people respond to warnings. It means that we are doing our job.

And I heard a story of one Chesnee family that heard the warning for Spartanburg County, they took the action specifically recommended in our warning bulletin, which was move to the center of your house, they did that and they survived the storm as their house fell in around them and then blew away.

Our aggressive approach caused us to issue many short reports of damage as they came in. As soon as a spotter would call in with a report or we would hear it on the amateur radio operator stationed in our office that day we would incorporate that into a warning bulletin, or we would send out a little short message simply saying "Severe damage ten miles south of Anderson" or something like that.

Some of the radio people I talked to later in Spartanburg recalled those in saying that they had a lot of impact and were very effective tools for them to relay to the public, and many people did recall hearing those.

In the weeks following the April 4th outbreak which was quite similar in that it produced a tornado in Spartanburg County, we were able to conduct several preparedness activities there because of the heightened awareness.

One of the things we did was introduce a computer program into the school system which is a locally developed thing developed actually while we were at Raleigh, and it teaches kids, school age children tornado safety rules, and one of the schools we got that into may have been impacted by the tornado, that was Boiling Springs Elementary. I do not know if it had any effect or not, but nevertheless that is one of the things we did because of the heightened awareness. We got a number of calls asking for programs and talks on severe weather in Spartanburg County.

And we conducted a spotters' training session on May 2nd, and I recall seeing some of the people in the audience at that meeting, and we discussed almost exactly in some cases the things which were going to happen three days later.

I do not think that when we have big outbreaks of major tornadoes like we had, I do not think we will ever be completely safe. A major tornado is not something that is dealt with very effectively by anyone because it is so devastating, it can form so rapidly and can do so many things, so regardless of the warning systems that we have in the future I think that we will always have some problems because of those outbreaks. It is just a very, very major storm, the most violent on Earth.

I could not imagine a situation—I mean this very sincerely—the media in this area have been very cooperative, very enthusiastic media, very enthusiastic emergency preparedness people. I have not had a situation where I felt more comfortable working with anybody, and I have really enjoyed my first year and a half in the area working with them.

The television and radio stations have done a number of interviews on severe weather. The print media, the newspapers have done features on severe weather and flash flood, both of which I am sure have helped a lot of people, and it is not every day that you see a relationship like that.

That concludes my prepared statement.

[The prepared statement of Mr. Jones follows:]

Statement of Wayne A. Jones
Official-in-Charge
National Weather Service Office
Greenville-Spartanburg, South Carolina
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Before the

Subcommittee on Natural Resources, Agriculture
Research and Environment
Committee on Science, Space and Technology
House of Representatives

August 7, 1989

Mr. Chairman and Members of the Subcommittee:

My name is Wayne A. Jones. I am the Official-In-Charge of the Greenville-Spartanburg National Weather Service Office, National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. I am pleased to be here to discuss the activities of our National Weather Service Office, specifically our activities related to the May 5, 1989 outbreak of tornadoes in this area.

Our Office has traditionally had a very experienced and capable staff with a fine reputation for public service in the upstate South Carolina area. We have also had strong relationships with the public and with local officials.

Recently, I have focussed my activities in two major program areas; I think both have had immediate positive impacts this year.

First, we have conveyed a message to our users that the upstate has experienced mild weather for the past 15 years and that people have grown accustomed to that weather. Therefore, we have concentrated our efforts toward re-educating the public, our spotters, the media, and local officials on the dangers of severe weather and the proper responses to it.

The last extended period of severe weather occurred during the early and mid-1970's when severe weather and flash flooding were common in the area. In 1973, the weather in upstate South Carolina was particularly bad, with several tornado outbreaks at different times.

Although the total number of severe weather events has increased during the 1980's, most in our area have been hailstorms or damaging windstorms from short-lived severe thunderstorms, which are the most common form of severe weather in the southeast United States. For the most part, our ten-county area has escaped the outbreaks of strong tornadoes which seem to be occurring with increasing frequency across the southeast, especially in other parts of the Carolinas.

Our second major activity is to provide effective service by gathering real-time storm damage information, incorporating it into updated weather warnings and forecasts, and then passing along that information as rapidly as possible through

such channels as local officials, NOAA Weather Wire, and the media. This approach results in improved responses by local officials and the public downstream of the severe weather.

So far this year, we have issued warnings for four out of every five severe storms occurring in our coverage area. We have confirmed seven tornadoes in the upstate this year, six of which occurred after a tornado warning was already in effect. For most of these storms, of which we were able to see the event developing upstream of northwest South Carolina, the lead times of the warnings have been in excess of 15 minutes.

This is an excellent record, one of which we are extremely proud. A large part of our success this year has been due to the predictability of three of our most severe weather outbreaks, i.e., the NWS noted well in advance of the storms that conditions were favorable for storm development. I caution, however, that many damaging storms occur without our being able to detect the conditions as they form upstream.

In the hours preceding the May 5 outbreak of severe weather, based on an outlook from the National Severe Storms Forecast Center (NSSFC), we decided on Thursday, May 4, to "beef up" staffing coverage for Friday evening (May 5). I changed my normal administrative work day to an evening shift so we would have double coverage scheduled from 8:00 am until midnight.

4

The threat of severe weather in the form of tornadic thunderstorms became more clear during early Friday. A small, but very intense, low pressure center developed near Atlanta, GA. At 2:21 pm EDT, NSSFC issued tornado watch number 183, effective until 9:00 pm that evening.

Starting at about 2:30 pm, our staff began to swing into an active severe weather mode: meaning an increase in the number of statements from our Office and the dissemination of information to agencies and officials and to emergency broadcast system stations. The staff on duty followed the severe thunderstorm activity as it developed in Georgia and moved toward the upstate area. Our statements on NOAA Weather Radio were revised to focus on the impending severe weather, and safety rules were inserted into the program messages.

Statements written by our Office at 2:45 pm and 3:45 pm indicated that severe thunderstorms and tornadoes would be possible in the upstate area later in the afternoon and evening, and mentioned that activity in Georgia could move into our area later. At shift change time we decided that three people would be required to handle the workload, and that we needed an amateur radio volunteer to assist gathering reports. Starting at 4:20 pm, we began to call the county emergency preparedness offices to alert them of the urgency of the situation.

At 4:33 pm NSSFC issued a second watch which covered the remaining upstate counties. This watch included the wording "...particularly dangerous situation..." meaning they had identified it as a "worst case" type of tornado threat.

At 4:35 pm we issued a statement which described the line of severe storms in Georgia, indicated that warnings were being issued there, and projected arrival in the upstate between 5:30 pm and 6:00 pm.

At 5:15 pm a statement was written to confirm that all counties in the upstate area were under a tornado watch and projected severe storms into Anderson, Abbeville, and Greenwood counties by 5:45 pm. During this time the spotter reports were indicating that severe thunderstorms were occurring ahead of the main line of storms. However, our radar imagery from the Athens, Georgia radar was poor, and we were unable to get a good handle on the specific cells and their locations. Still, we were able to deduce the approximate speed and direction of the storms and issued the needed warnings ahead of time.

At 5:19 pm the National Weather Service office in Athens, Georgia phoned us to report a possible tornado in Stephens County, which is just across the border from Oconee County. At 5:21 pm we issued a tornado warning for Southern Oconee County and Anderson County and at 5:23 pm Oconee County

reported a tornado near Westminster (the storm had crossed the border at 5:15 pm - another tornado occurred in Oconee County at 5:40 pm with the passage of the main line). At 5:24 pm we issued a tornado warning for Pickens County based on the latest reports, and at 5:36 pm we issued a severe thunderstorm warning for Abbeville County because of many reports of wind damage in Georgia. At 5:51 pm we issued a tornado warning for Greenville County because we could not determine there was any less threat for Greenville County than for Pickens. At 6:01 pm we issued severe thunderstorm warnings for Greenwood and Laurens counties because the southern end of the line of storms seemed to be intensifying and appeared to be more threatening than when it approached Abbeville County.

At about 6:15 pm we began to receive several reports of a tornado or funnel cloud near Boiling Springs. Several people later described the funnel as it moved across Northern Greenville County and into Spartanburg County. There was one report of a giant twin funnel in northeast Greenville County at 6:00 pm, which we did not receive until the next day.

At 6:18 pm we issued a tornado warning for Spartanburg County, and we included Laurens County because of a report of "Severe Damage" in Anderson County. At 6:36 pm we issued severe thunderstorm warnings for Union and Cherokee counties

based primarily on the consistent damage reports coming into our Office.

As best as we can determine, the Chesnee tornado caused major damage in South Carolina starting at about 6:20 pm until 6:35 pm when it crossed the North Carolina border. The storm has been classified as an F4 storm (one of the strongest types of tornadoes) and was a mile wide at some points.

Some people in the Chesnee area recall hearing the warning in the few minutes before the storm struck - some did not hear the warning but saw the storm coming. I have not talked to anyone in the area who was not aware of the storm as it approached - although I'm sure there are some.

I believe the low death rate speaks for years of community eduction and preparedness and for the soundness of the current warning systems. Following all three of the major outbreaks this year - many people I've talked to heard the watches and warnings and took action based on what they heard. I heard a story of a Chesnee family that heard the warning for Spartanburg County, took the action recommended in the warning (moved to the center of their house), and survived while their house fell in around them. Our aggressive approach to severe weather operations mentioned earlier caused us to issue many short, "one-liner" storm reports and statements as quickly as they came into our office. One of the Spartanburg area radio people, for

example, told me that the "...severe damage reported ten miles south of Anderson..." was broadcast and certainly had impact as the storm moved close to Spartanburg County.

In the weeks following a similar severe weather outbreak in April (which also produced a tornado in Spartanburg County), we were able to conduct several preparedness activities in Spartanburg County. We introduced into three schools a computer program designed to teach tornado survival skills to school age children. One of these schools may have had some children impacted by the May 5 tornado. Also, we conducted a spotter's training session on May 2, during which we discussed aspects of a major storm such as the one which occurred only three days later.

I think that when major tornado outbreaks occur we will never be completely safe. These are the most violent, rapidly developing storms on earth. I am very proud of the way our Office has met the challenge of issuing warnings of these storms this year and helping local governments prepare for them.

Finally, I could not imagine a situation where a National Weather Service Office could have better relationships with the local governments and with the media. The print media in the area have been most cooperative in doing features on severe weather and flash flooding. Likewise, television and radio stations have done a superb job in getting the warning

information out and in promoting severe weather education. It is really a pleasure to serve in the upstate area.

Mr. Chairman, this concludes my prepared statement. I will be glad to answer any questions you may have.

Mr. VALENTINE. Thank you very much, Mr. Jones and, of course, Dr. Friday.

I have a couple of quick questions and I will pass on to our colleagues. Is it true that the—I think you have touched on this, but I would like to get a more specific answer—is it true that NEXRAD would not be able to detect tornadoes beyond a 50-mile distance?

Dr. FRIDAY. Yes, sir. With my statement earlier I tried to point out——

Mr. VALENTINE. It depends on the size——

Dr. FRIDAY [continuing]. It depends on the size and the exact location of the storm, and various other parameters.

NEXRAD will be able to detect very large tornadoes probably at distances of greater than 50 miles, but we have seen situations in Oklahoma where we have missed tornadoes that were as close as 35 miles, simply because they were very small, but again the point is that we do not have to detect the tornado to be able to identify a storm that is generating a tornado or will generate a tornado, and that is the critical point there.

Mr. VALENTINE. And I suppose whether or not the NEXRAD coverage from Columbia would detect tornadoes in the Greenville-Spartanburg area again would depend on the size of the storm, would it not?

Dr. FRIDAY. Yes, sir, that is correct. They will probably not detect most tornadoes over the Greenville-Spartanburg area because it is a substantial distance from the site, but it is still very close to the site in terms of identifying the type of storms that are generating the tornadoes, and I will say one thing, it is much better than the data that Mr. Jones currently has to work with from the Athens radar.

Mr. VALENTINE. Congresswoman Patterson.

Ms. PATTERSON. Before I begin, let me tell you I did not identify everyone at this head table, and I regret that. I should have also made notice of Mr. Wesley Warren who represents the committee and works directly with the minority members, and the Ranking Minority Member is Claudine Schneider of Rhode Island, so we are glad to have you, Mr. Warren.

Because of several of the questions that have been raised before this meeting I would like to pose, and I suppose to you, Dr. Friday, the news said this spring that there was a proposal or plan—I do not know if it was a strategic plan or whatever—to close I believe it was 132 weather stations, that was in the media down here, and we heard about that plan to close 132. Is there such a plan to close so many weather stations, and is the Spartanburg-Greenville in that plan?

Dr. FRIDAY. The original proposal for the 1990 budget submission to Congress include a proposal to combat the real serious fiscal difficulty we had, recognizing the fact that it was going to cost a great deal of money to modernize the weather service—we are talking about a major, a substantial capital investment for all the new equipment and new technologies that will be going in around the country.

The proposal made to Congress initially was that in order to fund the modernization we would close some of the stations around

the country, and the number was very close to the number that you quoted—I do not recall the exact details on that.

That was released in the press, there was as you can imagine a very serious concern expressed across the country. As the new administration came on board and our Secretary of Commerce, Mr. Mosbacher, had a chance to review what had gone before him he basically made the decision that that was not a very good thing to do, it did not make any sense to start closing weather stations before we had the capability of replacing the services, so working with the Congress, working with the other members of the executive branch there are no plans to close any weather stations now across the country prior to the implementation of the new technology in order to provide the service continuity. In other words, there are no plans at all to do that.

Ms. PATTERSON. Several things crossed my mind at that time, and I just wonder if—I believe that strategic plan was developed by the administration and presented by Office of Management and Budget, or as we know it the OMB—I just wonder if OMB altered that strategic plan to represent the administration's policy rather than based on real science and technology.

Dr. FRIDAY. There was a long series of discussions and negotiations on the development of the strategic plan, taking into consideration science and technology, taking into consideration total overall fiscal constraints, trying to balance the total cost of the plan with the services to be provided to the country.

It is a long discussion, Ms. Patterson, and it is a difficult one to try to remember exactly what happened at every stage of the game.

Ms. PATTERSON. Do you remember that the Spartanburg-Greenville weather station was in the original plan before OMB made the cuts?

Dr. FRIDAY. In one of the very early concepts of a strategic weather service plan we included continuation of the Greenville-Spartanburg office, not as a 24-hour-a-day office as it currently is, but rather as what we were calling a community outreach or community liaison office in which perhaps two people would be here in order to provide the contacts with the local emergency management officials and making sure that that information was provided on a routine basis that everyone knew exactly how to get their weather information.

In the interest of economy the final structure of the plan calls for those sorts of functions to be handled out of the existing proposed, or the proposed 115 total offices.

Ms. PATTERSON. Another question I guess that Mr. Jones or you could answer for me, I keep hearing, and I am sure the people in the audience—I am learning a lot, and when we talk about this NEXRAD, the next generation of radar and we talk about the range of it, and we talk about tornadoes because that is what brought our attention to the situation here in our area, but I am concerned about all severe weather, you know, tornadoes, but our school folks need to know in the winter time if a severe snow storm is coming, and we hear about the radius of that NEXRAD once that new radar system gets put in, and if they put it in Columbia, and we talk about the radius of it, will in fact the radius of a

NEXRAD system in Columbia give good weather service of all severe storms to our area in plenty of time to alert our people?

I do not mean to put you on the spot. You all are the experts.

Dr. FRIDAY. You are kidding. Okay.

Well, one thing that as having spent 26 years, 28 years now—amazing how time flies—in the weather business I know better than to say that we will never have a mistake as far as a weather forecast is concerned.

I will say that the types of technology that we intend to put in in the Carolinas and in the surrounding states I believe will be able to provide that better coverage. But bear in mind that before we do anything to change the local office structure to remove any local office and so on we have to prove that to you, you know, to show with test results, with hard concrete results that we are able to provide that service.

Ms. PATTERSON. And are you all going to do some of these tests in our area of the United States rather than just in the Midwest because we have talked about the differences?

Dr. FRIDAY. Yes. Let me identify a few of the things that we are in the process of doing now.

Clearly we developed some initial concepts in the center part of the United States because that is where a lot of the research facilities were that we were taking advantage of. The first test of the modernized structure of the weather service will also take place in the Kansas-Oklahoma-Colorado area. We have a large variety of weather, everything from the severe storms in the spring to the winter storms with the snow storms and all, so we see that, but we understand also we have not taken into consideration the marine weather and the coastal weather that we have.

The second NEXRAD that will be going in will be going in in Melbourne, Florida. We will immediately get some valid information in the coastal environment, in a near tropical environment, and also we will have the additional advantage of being able to support the space shuttle operations, which of course are very important, and that will provide the first of our experience out of the area of the central part of the United States.

And then we will continue to work as we move across the country so that each new installation in essence becomes a small development effort, or a small research and development effort to make sure that we know—we are going to be learning from each one of these installations.

Ms. PATTERSON. It is my understanding, and again these gentlemen on the committee would know better than I, but it is my understanding that the initial contract for purchase of these NEXRADs allows for ten that have not been assigned to a location. If in fact we show that there is a need for one in our area, would that be a possibility as we talk about NEXRAD and modernization in the Greenville-Spartanburg area?

Dr. FRIDAY. Well, the NEXRAD program consists of three different agencies, the Department of Defense, the Department of Transportation and the Department of Commerce, National Weather Service.

In order to provide the flexibility, particularly possibly with DOD needs, overseas locations, the contract has been structured so that

there is a fixed price option for an additional ten radars as you point out. We do not have plans for those ten radars, there is no budget for those ten radars. If indeed any of the agencies finds an overriding need for those we have the procurement capability of buying one of those at a good solid, a fixed price.

Ms. PATTERSON. I guess at this time that answers my questions, but I will say to you, Dr. Friday, and to our visitors from outside the district, we did not purposely plan the storm that came through here last night that took off power in some areas, but that does show you how—I do not believe, I was listening to the weather last night, I am not sure how much of a warning some of those folks had that their power was going off, so we look forward to working with you and we appreciate your being here.

Mr. VALENTINE. Mr. Price.

Mr. PRICE. Thank you, Mr. Chairman.

I would like to clarify from one or both of you the comparison between the present capacity, the capacity of the present system and the capacity that NEXRAD would have, first of all to specifically detect a storm, leaving aside the question about the developing storm conditions. You say, Dr. Friday, that the range within which the radar can actually pick up a storm under NEXRAD would be 60 to 80 miles, something like that?

Dr. FRIDAY. That is a rough working figure. That may be actually a little high.

Mr. PRICE. Depending on the——

Dr. FRIDAY. Depending on the size of the——

Mr. PRICE [continuing]. Depending on the size of the storm.

How does that compare with the radar you are working with now?

Dr. FRIDAY. The present radar system does not detect tornadoes directly, period. You may have heard reference to a hook echo on a storm. That is a structure on a storm which we have learned to associate with an internal tornado or a tornado in the storm, but the present radar systems that we have cannot detect directly a tornado itself. They only look at the storm structure, and the developments that we have had over the last several years have provided us then with information on the shape of the storm, the movement of the storm and other factors which we are able to identify the type of storms that actually produce tornadoes.

So first of all, the new generation of radar, NEXRAD, provides us the first capability of directly measuring the wind speed inside the storms, and therefore of directly detecting and measuring, identifying a tornado.

But the present radars have no capability whatsoever to do that. The present radars only see the storm structure in the amount of water droplets that are in the storm itself. That is what they observe.

The NEXRAD not only sees that with a much higher resolution and a much finer detail than the present radars, but also sees the internal motion in the storm, and that is where we can actually look inside and see what is going on.

Mr. PRICE. So even acknowledging that limited range, it still represents an improvement on our present capacity, even for a locale

such as Greenville-Spartanburg that has its own weather station——

Dr. FRIDAY. That is correct.

Mr. PRICE [continuing]. Or that has a weather station immediately in the area?

Dr. FRIDAY. That is correct.

Mr. PRICE. Now I would like to make sure I understand what you are saying about the import of these limits on detection capacity.

As I understand it, you are acknowledging that those limits exist, those limits that are in actually detecting a storm, but what you are saying is that the improved predictive capacity does not depend on that.

Dr. FRIDAY. That is correct, sir.

Mr. PRICE. The improved predictive capacity depends on the ability to pick up pretornadic conditions, and this the NEXRAD system will do considerably beyond this 60 to 80-mile range, and you are saying the net result will be an improvement on the present system even at the outer limits of the range?

Dr. FRIDAY. We believe that to be the case. It has been the case in the existing tests in Oklahoma and in Colorado. We have shown improvements in our capability even out as far as 125 miles over what our predictions had been at the station with the older technology, so we see significant improvements out over the entire range of this radar and, as a matter of fact, even at the fringes with the new technology we are better than we were at the center with the old technology.

Mr. PRICE. Well, I appreciate that clarification.

I think it is very important in discussing these matters that we not pose tradeoffs that we ought not to be posing.

In other words, the need for an adequate network of weather stations should not blind us to the need for this next generation technology. It is important to have both. It would be a sad mistake in my opinion to pose some kind of tradeoff where we are inhibiting the development of this new technology just to keep weather stations open, or conversely that we are closing down weather stations prematurely just to move ahead with technology development. It seems to me we need to have an adequate balance, and I am distressed that the appropriations that we are looking at for next year may in fact prevent the timely development of that NEXRAD system and, as I said in my opening statement I very much hope we can correct that in the Senate and in the conference committee as we look at the current appropriations bill.

Mr. Jones, I am impressed with your statement.

It seems to me that there is a lot that you did right, and I know that the focus here has been on the lack of an adequate warning that many people had and, of course, that is one reason we want to develop this next generation system and have more lead time, but your foresight in beefing up your personnel coverage and in getting warnings out, it seems to me a lot of that is very impressive, and you are to be commended for it.

You do note some ways in which the system fell short. On Page 5 you talk about the poor radar imagery from the Athens, Georgia radar, unable to get a good handle on the specific cells and their locations you say.

You refer on the next page to the report of a giant twin funnel in northeast Greenville County which you did not receive until a day later, and which would have been very helpful to you. I am sure there are other instances, those are the two that I spotted.

I wonder if you could help us link those specific failings with this new technology we are looking forward to. How much of this would have been avoidable had you had a radar system, had access to a radar system with the capabilities that NEXRAD will bring us?

Mr. JONES. Having not worked with NEXRAD, I do not know that I can answer.

Mr. PRICE. Maybe Mr. Friday can supplement your testimony as well.

Mr. JONES. There were some problems with timing because of the spacing of the displays that we got from Athens, I think we got four during the outbreak, and because of the timing problems we were not able to clearly keep up with that tornadic cell as it accelerated.

A radar would have certainly helped with that part of the problem. In respect to its location, you know, I am not certain.

What was the remainder of the question?

Mr. PRICE. I just asked if this whole network of improved technology, NEXRAD, also the improved computer system, improved communication system, I am just wondering if it is possible to say how these anticipated improvements would have made it possible to avoid these problems.

Mr. JONES. I would suppose that the interactive systems of the future would probably handle a situation like that much better, but having not worked with that technology I really cannot answer.

Mr. PRICE. Dr. Friday.

Dr. FRIDAY. Let me first of all point out the fact that I agree with your assessment. I believe that Mr. Jones did an excellent job of the work that he did that night and that his staff did. It was a remarkable job.

I have—this was my first visit to his office, and when I looked at the displays that he is receiving from the Athens radar last night it is amazing that he was able to provide as good a warning as he did with that quality of information.

Now, we are improving that for him in the near future, he is getting an improved display which is going to help somewhat, but the next generation weather radar would present a much clearer display of that equipment, or that storm situation, and furthermore he would not have been subjected to the infrequent update of that information.

The NEXRAD is scheduled to, is programmed to operate basically so that it completely looks at the entire atmosphere every five minutes, so that every five minutes you would have a new view of exactly what was going on, and then that information is made available in essence to everyone that needs it, so there would be a much better information flow.

The interactive systems, the computer systems would certainly have made it easier for his staff to generate the warnings and get those out rapidly as opposed to having to do as much manual work as they do at the present time, and indeed I do want to highlight

the foresight that Mr. Jones had in being able to bring on that extra staff. I would point out the fact that he used 50 percent of his staff for that one storm outbreak.

Mr. PRICE. I know we need to move on to our other panels. Let me just ask one further question.

We are going to be—Mr. Valentine and I are going to have to catch a plane probably before the hearing is completely over, and so I want to anticipate one exchange that we might not be able to engage in, it has to do with a witness on a panel later this morning from North Carolina, Mr. Broome from the Charlotte-Mecklenburg Emergency Management Office.

I think some of his testimony you have probably already answered, but I would just like to pose his assertions more directly and let you respond briefly. We will hear from him later.

Here is what he says in a letter dated July 24th:

> Recent information admitted to by the management team of the new program has revealed that there are gaps in coverage.

Again referring now to NEXRAD,

> At certain distances there would be no weather information for weather conditions below 10,000 feet. I am not sure we can get an accurate portrayal of our weather conditions from a center located 80 to 90 miles away, and one which cannot monitor below 10,000 feet.

How would you respond to that criticism?

Dr. FRIDAY. The part of the—part of that criticism the response would be the same as I have made as far as the range and exactly how far we can see with the radar.

Mr. PRICE. I understand that.

Dr. FRIDAY. The radar beam itself does not follow along the surface of the Earth. It follows on a slightly curved path, but the further you go away the radar is at a certain altitude above the Earth's surface, so by the time that you are out to 125 nautical miles the lowest that you can view in the atmosphere is down to 10,000 feet.

Now, with respect to the severe storms, the thunderstorms that generate the heavy rains and the tornadoes, the damaging winds, those clearly are viewable well above 10,000 feet. In other words, those storms may exist from something on the first few thousand feet up to 25, 35, even higher, 35,000 feet, even higher, so we will clearly be able to identify the storms.

The further you go away the less you will be able to measure in detail the structure of the atmosphere at those altitudes below 10,000 feet, but as far as the severe storms is concerned our experience so far to date shows that we have enough information from what we are able to see above 10,000 feet to be able to accurately forecast and track those storms.

Mr. PRICE. Thank you very much.

Thank you, Mr. Chairman.

Mr. VALENTINE. Thank you, gentlemen, very, very much.

The next panel consists of TV meteorologists, Mr. Charlie Gertz from WYFF-TV in Greenville; Mr. Jack Roper, WSPA-TV in Spartanburg; and Mr. Ken Bostic, WLOS-TV in Asheville.

Let me say here that—Mr. Price has touched on this, and I might have mentioned it earlier—we have to catch an airplane to

go back to Raleigh-Durham and be leaving here about 11:30 so as we are setting up for this panel I will express again for both of us our pleasure at the opportunity to be here in your midst and to be in the district of our distinguished colleague Liz Patterson, and we will turn the gavel over to her at this time to proceed with the hearing.

Ms. PATTERSON. He does not know what he is doing turning the gavel over to me. We will move faster.

I am going to ask each of the witnesses if you will limit your statements hopefully to five minutes so that we can have questions with you if you will. I do not see Charlie.

Mr. BROWN. I am here on behalf of Charlie.

Ms. PATTERSON. Oh, excuse me, Lee.

STATEMENTS OF LEE BROWN, WYFF-TV, GREENVILLE, SC; JOHN C. ROPER, WSPA-TV, SPARTANBURG, SC; AND KEN BOSTIC, WLOS-TV, ASHEVILLE, NC

Mr. BROWN. My name is Lee Brown, I am the assistant news director at WYFF Television.

Ms. PATTERSON. If you all will, move the mikes and be sure to speak into them so all of our folk can hear you.

And, by the way, your full statement will be put in the record. For the time today we just want to have—we will have the opportunity to read your statements, but we want you to make them brief.

Mr. BROWN. All right. To repeat for those who may not have heard, my name is Lee Brown, I am the assistant news director at WYFF Television in Greenville, and like my colleagues here at the table we represent part of the Greenville-Spartanburg-Asheville market which is about 29 to 30 counties over parts of three states, but largely in this discussion upstate South Carolina is the focus, and I do apologize for Mr. Gertz' absence. He regretted very much his inability to be here, but had to be out of town on business.

I am going to touch on several things that he pointed out in his statement, which you have copies of, and I will just read selected portions verbatim to make the points that he wanted made, and obviously in references here to "my" and "I" those are obviously his references, but I will read them as he has put them:

My assessment of the National Weather Service in severe storm forecasting and issuing warnings is a very positive one. Being a professional meteorologist with 44 years of hands-on operational experience—more than 20 years of which has been in radio/television broadcasting—and I might add about nine of those 20 have been here in upstate South Carolina—I have drawn heavily upon the NWS in the receipt of information relative to severe storms in a timely manner so as to in turn advise the public in my particular scope of geographic coverage as to severe weather expectations and developments. I have without exception found the NWS information timely and of a character strongly reflecting their acceptance of the responsibility mandated by Congress.

My view of the level of coordination and cooperation between local, state and federal officials and the media during hazardous weather conditions was requested. With some assumption I con-

clude from personal observations through the years that this coordination and cooperation exists and functions well during real weather emergencies. I feel strongly, however, that there exists a great gap in local emergency preparedness and warning systems that adequately embrace the needs of the general public.

Regarding the NEXRAD weather system, there is no question in my mind that the highest state-of-the-art equipment should be placed at the NWS Greenville-Spartanburg Airport. This is a geographic area of burgeoning growth subject to meteorological extremes which can be best handled on-site rather than from remote locales. The effectiveness of NEXRAD diminishes with distance from the target, as has been earlier pointed out by the earlier witnesses. The effective limits of NEXRAD as a positive detector of extreme winds is on the order of 30 nautical miles, thus making it mandatory at a local site if it is to serve its purpose.

In response to the request for operational changes that could improve the timeliness of hazardous weather warnings, I have few. However, the headings on watch and warning messages are inordinately long and cumbersome. Television time is expensive, and the message itself is the meat of importance which the public needs, often right now. Wading through cumbersome headings takes time, uses space and often diffuses the impact of the message itself.

In conclusion, I appreciate the solicitation of our views and opinions and particularly appreciate the committee's visit to our area to discuss this vital matter.

My afterview of the May 5th tornado episode is that the local office of NWS performed in a totally professional manner while somewhat handicapped in state-of-the-art equipment not on site.

Thank you.

[The prepared statement of Mr. Gertz follows:]

P.O. Box TV4 505 Rutherford Street
Greenville, SC 29602
803 242-4404

A Division of Pulitzer
Broadcasting Company

WYFF TV
GREENVILLE

August 1, 1989

Committee on Science, Space & Technology
U.S. House of Representatives
Suite 2321 Rayburn House Office Building
Washington, DC 20515

Gentlemen of the Committee:

In response to your kind invitation to appear and submit comments and suggestions in regard to severe weather coverage in our area, I submit the following in writing. It will cover the various points in which you express particular interest and input in the order raised in your letter of July 19, 1989.

My assessment of the National Weather Service in severe storm forecasting and issuing warnings is a very positive one. Being a professional meteorologist with 44 years of hands-on operational experience (more than 20 years of which has been in radio/television broadcasting) I have drawn heavily upon the NWS in the receipt of information relative to severe storms in a timely manner so as to in turn advise the public in my particular scope of geographical coverage as to severe weather expectations and developments. I have without exception found the NWS information timely and of a character strongly reflecting their acceptance of the responsibility mandated by Congress.

At the WYFF Television WeatherCenter, we have an excellently equipped meteorological facility and I enjoy unlimited cooperation from my supervisors in decision making as to issuing watches, warnings and statements regarding severe weather. Our basic equipment package is not limited to, but includes an excellent meteorological radar, high speed state of the art teletype (satellite acquired) and DIFAX facsimile equipment. The reliability of those data gathering sources is excellent, however I must note with some emphasis that the good old telephone frequently gives me more timely information from a usually reliable source when severe weather develops. Curiously enough, severe storms tend to evade the network reporting stations in a peculiar but regular manner. Once severe weather develops it is generally voice communications from law enforcement persons, observers or general public, enhanced by our own radar screen which enables us to track severe weather and update and inform areas upstream as to possible dangers.

You next request my view of the level of coordination and cooperation between local, state, federal officials, and the media during hazardous weather conditions. With some assumption, I conclude from personal observations through the years that this coordination and cooperation exists and functions well during real weather emergency. I feel strongly, however, that there exists a great gap in local emergency preparedness and warning systems that adequately embrace the needs of the general public.

Not to cast a shadow upon my sister industry radio, but to bring to the attention of managers and announcers alike from stations that lack an on-staff professional, some training is definitely needed for duty shift announcers in the dissemination of hazardous weather information via radio. Radio is more apt to maintain air capability in severe weather than is television and the public draws very heavily upon this media for specific up-to-date and precise information (particularly if huddled in a storm shelter without tv or possibly the benefit of electricity). Radio personnel should be encouraged to draw from professional sources for their information.

Regarding the NEXRAD radar system, there is no question in my mind that the highest state of the art equipment should be placed at NWS Greenville Spartanburg Airport. This is a geographic area of burgeoning growth subject to meteorological extremes which can be best handled on-site rather than from remote locales. The effectiveness of NEXRAD diminishes with distance from the target. The effective limits of NEXRAD as a positive detector of extreme winds is on the order of 30 nautical miles, thus making it mandatory at a local site if it is to serve its purpose.

In response to your request for operational changes that could improve the timeliness of hazardous weather warnings I have few. However, the headings on watch and warning messages are inordinately long and cumbersome. Television time is expensive. The message itself is the meat of importance which the public needs, often "right now". Wading through cumbersome headings takes time, uses space and often diffuses the impact of the message itself.

In conclusion gentlemen, we appreciate your soliciting our views and opinions and particularly appreciate your visit to our area to discuss this vital matter.

My afterview of the May 5th tornado episode is that the local office of NWS performed in a totally professional manner while somewhat handicapped in state-of-the-art equipment not on site.

Very respectfully submitted,

Charles M. Gentz
Chief Meteorologist
WYFF TV

Mr. ROPER. Let me give you copies of this.

Ms. PATTERSON. I said Wayne. Excuse me, Jack Roper. Please forgive me.

Mr. ROPER. That is OK

Ms. PATTERSON. He will make me disappear if I do not say the right thing! He is a magician on the side. [Laughter.]

Mr. ROPER. Let me read from my prepared statement which you now have copies of, and then a few add-on comments.

First of all, thank you for the privilege of having the opportunity to sing the praises of the National Weather Service in Greer. Wayne is smiling, that is a good indication.

In the area of effectiveness I think the staff is issuing severe weather warnings as soon as humanly possible. Being the six and eleven weathercaster for WSPA-TV in Spartanburg I have developed a very close relationship with the NOAA office in Greer. Because of their trust in me—and it goes both ways, and my trust in them—I can actually prepare early to alert my audience to severe weather warnings. With a simple phone call instigated by me I can know of upcoming warnings before actually officially issued on the wire machine, and I might digress just a little bit, official warnings have to come from the National Weather Service. Some hotshot weathermen some places may get on TV and issue them by themselves. That just does not happen in this market. When a warning does become official because of some early work on our part, we can actually prepare to get on the air some three to five minutes ahead of other broadcast sources. We take pride in this.

Incidentally the WSPA-TV audience is approximately 275,000 people for our six o'clock news alone. We are currently rated number one by Mr. Neilson for the upstate of South Carolina. That may sound like a commercial, but let me continue.

Remember, too, that the upstate is the most populated area in South Carolina. What all this means very simply is this: The WSPA audience at this moment is the largest mass of people potentially to hear emergency information first, so time is of the essence. Through the cooperative efforts of NOAA in Greer TV-7 gets emergency information to the public very, very quickly.

If new radar is installed anywhere in the state of South Carolina, it should be done here in the upstate of South Carolina at our NOAA office in Greer. One reason, because of the state's greatest population being here in the upstate. Not in the midlands, not in Charleston. In Charleston half of the TV signal is in the ocean. Just a little aside there.

The I-85 corridor between Charlotte and Atlanta is indeed a boom area, not for just growing population, but also of course for the increased industrial construction.

Consider all of these things and the greater occurrence of tornado outbreaks since especially the mid 1980's, and I remember being in eastern North Carolina as a weathercaster—Wayne, you were in Raleigh, and of course the outbreak began around Newberry County in the upstate of South Carolina, and we seem to have more and more occurrences as the years progress.

It becomes very much obvious to us that the upstate needs to keep the National Weather Service in Greer, and also acquire the updated NEXRAD radar system.

It is my opinion that the local NOAA office is doing an excellent job in serving the public with severe weather strikes. As a weathercaster I enjoy a marvelous relationship with these gentlemen. I depend on them, I think they depend on me to get that emergency information to the public as soon as possible.

I leave here with more concern than I came with by hearing Dr. Friday's testimony about the capabilities of the NEXRAD, slash I assume Dopler radar that will probably be assigned to Columbia unless we can change some folks' minds.

If indeed there are limitations outside of 50 air miles with NEXRAD being stationed in Columbia, we have not even talked about the capabilities of tracking on-ground tornadoes. It may be well and good to, you know, indicate the supercells as they form in the clouds, but touchdown of course, and only after touchdown that is when the injuries occur. That might be later we can touch on as to whether NEXRAD can even track outside of 50 miles a tornado after it touches down.

This could be a new Edsel, you never know. It could take years to work the bugs out. This is another potential problem that perhaps we should investigate.

As Mr. Bostic here and I, we like to show radar on our TV stations, and I am wondering with NEXRAD will we have the capabilities of showing radar outside of 50 miles on our TV station. We currently tap into National Radar summaries and local radars out of Athens, Georgia and Charlotte. Indeed, will this be a potential for us to use the NEXRAD on our visuals as we go on the air with our information.

This gentleman, his title is Emergency Preparedness Meteorologist. Wayne Jones is invited I am sure not just to talk to our spotter network, and who could live without them, but also to talk with emergency preparedness people within the community but, Wayne, do you ever talk to civic groups, do you ever go to schools, do you ever actually go into—well, Rotary Clubs and make a speech and things like that?

Mr. JONES. Yes.

Mr. ROPER. If you close this office, you are closing a very vital educational link to the public, and that is that man's job, and I believe that is part of his job description, Emergency Preparedness Meteorologist, and he is here for one reason, to educate the public.

Personally I would rather keep the local spotter network and emergency preparedness people that work with us and keep Athens radar than to have NEXRAD in Columbia. It is frightening. Please do not let this happen.

Thank you.

[The prepared statement of Mr. Roper follows:]

WSPA-TV
A CBS AFFILIATE SERVING THE GREENVILLE • SPARTANBURG • ASHEVILLE MARKET

August 3, 1989

To whom it may concern:

It is my pleasure to sing the praises of our local N.O.A.A. office in Greer, South Carolina.

In the area of effectiveness, I think the staff is issuing severe weather warnings as soon as humanly possible.

Being the 6 and 11 p.m. weatherman for WSPA-TV in Spartanburg, South Carolina, I have developed a close working relationship with the N.O.A.A. office. Because of their trust in me I can actually prepare early to alert my audience of any severe weather warnings.

With a phone call from me I can know of any upcoming warning before it becomes officially issued over the wire machine. When a warning does become official I have already prepared to get it on the air some 3 to 5 minutes sooner than other broadcast sources.

Incidentally, WSPA-TV's audience is approximately 275,000 people for the 6 p.m. news alone. We are currently rated #1 in audience viewership in the Nielsen ratings for upstate South Carolina.

Remember too that the upstate is the most populated area of South Carolina. What all this means is that the WSPA audience is the target mass of people to hear emergency weather information first. With the cooperative efforts of N.O.A.A. in Greer, WSPA-TV gets emergency information to the public very, very quickly.

If new radar equipment is installed anywhere in South Carolina it should be done here in the upstate at the N.O.A.A. office in Greer. One reason is because of the state's greatest population being here in the upstate, not the midlands or the coast. The I-85 corridor between Charlotte and Atlanta is drawing more than just people. This area is experiencing a boom in industrial construction.

Consider all of these things and the greater occurance of tornado outbreaks in the upstate since the mid 1980s. It should be obvious that the upstate needs to keep the national weather service office in Greer.

It is my opinion that the local N.O.A.A. staff is doing an excellent job in serving the public when severe weather strikes. As a TV weatherman, I enjoy my working relationship with them. I depend on them and they depend on me to get their emergency information to the public as quickly as possible.

Sincerely,

WSPA-TV

John C. Roper

John C. Roper

COMMUNICATIONS PARK • P.O. BOX 1717 • SPARTANBURG, SOUTH CAROLINA 29304 • PHONE 803 576-7777

JCR:mdt

Ms. PATTERSON. Thank you very much, Jack.

[Applause.]

Ms. PATTERSON. Next we will call on Ken Bostic.

Mr. BOSTIC. As you know, and you have a copy of my statement, it was rather brief. I did comment on the way I felt the weather service did act on the outbreaks that we had back in the spring.

I really do think, and I said in my statement that they are handicapped mainly because they are on a dedicated line with the Athens radar. Now, we operate with the same system at our TV station, but at the same time I have the ability to sit and look at Atlanta, Charlotte, Columbia and Athens radar all at the same time.

On this particular day I had—both days as a matter of fact I noted that these storms developed west of Atlanta and just about moved right up I–85. It was almost like they were just following I–85. And I did feel like he was handicapped somewhat having only Athens, Georgia to look at, whereas I can sit there in my studio and look at four or five different sites, and once those storms got into eastern Anderson County I would switch over to Charlotte and I would see even a better picture. Consequently, the weather service office in Asheville and and Greenville-Spartanburg both have a dedicated loop to Athens.

Being at the Asheville television station we are kind of limited in what we do in upper South Carolina, but we also have to look at the entire market. Now, at the end of this month we will have the largest signal and the greatest coverage area of any of the stations in the market. As some of you may know, we have just purchased the Anderson TV station. A lot of folks do not realize that there are several counties in northeast Georgia that are in our market and, of course, WLOA in Anderson will cover those counties, plus everything down toward Abbeville, Greenwood and Anderson, sort of the western edge of the market, so they will have total coverage there.

As always, when I prepared my statement and mailed it off you always think of what you wished you had put down after it is in the mail, and one of the big concerns that I have here is not only did I hear today that the effective radius of the Dopler would be about 50 miles as far as good tornado forecasting—well, if you put that in Columbia, we are only talking about seeing good pictures up to about Newberry, Laurens County, and unfortunately the gentleman from North Carolina has left, but what really concerns me is in North Carolina we are going to put three radar sites there, and not one of them is west of Raleigh-Durham. They will be in Wilmington, Morehead City and Raleigh.

Now, when you take one of the largest cities in the Southeast, I would rather have that radar site in Charlotte then Columbia. You would see a better picture here in Greenville-Spartanburg from a Charlotte radar site than you would from Columbia, so that is one of my major concerns right now is if we go to NEXRAD, fine, but but let us put them in strategic places, let us get them—you know, the mountains of western North Carolina is the hardest place in the world to see good radar pictures. Dopler will not help us that much.

I have to kind of agree with Jack, I would rather have Athens radar showing us pictures of western North Carolina than I would something down in Columbia, and if I do not have anything in Raleigh, I mean west of Raleigh I would be really limited.

So I would hope that when all this is finalized and put on paper that we act with a little bit of common sense, and let us try to get the upper part of South Carolina and western North Carolina a little bit better coverage than we already have.

One of the real things that irritates me now is the state of Georgia has six radar sites covering the whole state, South Carolina has two, nothing north of Columbia. Western North Carolina has four radar sites, three of those are east of Raleigh.

So we are really limited here in this part of the country, and we need help, and I appeal to you for that help.

Thank you.

[The prepared statement of Mr. Bostic follows:]

13
WLOS TV
ASHEVILLE GREENVILLE SPARTANBURG
P.O. Box 1300, Asheville, NC 28802 / 288 Macon Ave., Asheville, NC 28804 / (704) 255-0013

July 27, 1989

Statement of assessment of effectiveness of the National Weather Service prepared by Ken Bostic at the request of James H. Scheuer, Chairman, Subcommittee on Natural Resources, Agriculture Research and Environment.

On Friday, May 5th, 1989, a line of strong thunderstorms developed west of Atlanta around 2 PM, and moved northeast across Georgia, strengthening as they accelerated into the upstate of South Carolina around 4:30 PM.

The first reports of tornado activity occurred in Stephens County near Toccoa. As the storms crossed into Anderson and Oconee Counties around 5 PM, tornado warnings were issued by the National Weather Service at the Greenville-Spartanburg Airport.

These storms continued moving in a northeast direction across northern Greenville County, into northern Spartanburg County, where major damage was reported in the Chesnee area. The storm then touched southern sections of Rutherford County with minor damage being reported, followed by heavy damage again minutes later in Cleveland County.

Rutherford and Cleveland Counties are in North Carolina, and are under Asheville and Charlotte Weather Service Offices.

These storms were the second group of such storms to move across this same area within three weeks.

I feel the warnings put out by the Greenville-Spartanburg Weather Service Office were the best they could do given the conditions and radar equipment that they have to rely on.

In the Western Carolinas we have only Athens, Georgia to give us radar pictures of incoming storms from the west.

The weather service had warnings out as soon as they got sightings, which leads me to believe that our whole warning system is too slow for tornado activity.

In this part of the country we have a mountainous terrain, and sightings of tornadoes are extremely difficult.

Continued

The present radar systems used in this part of the country are outdated and not equal to the new Doppler Systems.

We do not have radar sites at the Greenville-Spartanburg and Asheville Airports. Therefore, relying on radar some 100 miles away makes forecasting severe weather and issuing warnings even more difficult.

We also have reported the proposed closings of our two airport Weather Service Offices, which will put a great deal of pressure on radio and television stations to get the severe weather statements to the public.

Our Weather Service Offices work well with the local media, and in my 13 years reporting television weather, I have to say that both of our Weather Service Offices have operated in a very professional manner.

I would suggest that the Weather Service Offices all over the country should have regular yearly meetings with local media and work on ways to improve the warnings systems we now have in place.

Ken Bostic

Ken Bostic
13 WLOS TV
Asheville, N. C.

Ms. PATTERSON. Thank you very much, gentlemen.

Let me ask a couple questions, and then I will turn it over to my colleague from North Carolina.

Ken, because yours is freshest on my mind, did I understand you to say that when the tornado came this spring that because the radar was spotty from the Greer weather station that you turned to radar information from some places out of North Carolina?

Mr. BOSTIC. We have the exact same KVAR system that they have at both of our weather service offices.

Now, they are on a dedicated line to Athens, Georgia, which means that is just about all you use—is it not?—normally you just use the Athens picture.

Our radar equipment allows me to look at any radar site in the country, but it also gives me the ability to look at four or five at time, and that particular day I started looking at Atlanta because we knew the storms were developing there. As they moved northeast I would switch over to Athens and watch those storms, and when they get into eastern Anderson County I generally will switch to Charlotte because I get a better picture out of Charlotte, and again this gives us a little more ability to see the pictures than they do at the weather service office.

The other thing that concerns me about that is we have two counties in our market and, you know, as broadcasters we look at this as a market, this is Asheville-Greenville-Spartanburg—this is not just upper South Carolina—we have two counties, Polk and Rutherford County that cannot be seen from the Asheville Weather Service office, they cannot determine where a severe storm is in those two counties with their radar system, and because Cleveland County is the cutoff line from the Charlotte weather service office, to me those two offices really should come under Greenville-Spartanburg, but we do not cross state lines in the weather service office.

To give you an example, that same outbreak of tornadoes that occurred on May the 5th, the Asheville Weather Service finally put out a warning at 6:45 for Rutherford County for a tornado warning. Well, on my radar picture from Charlotte that storm was well east of Shelby moving into Gastonia when they finally got the warning, and I called them and they said "We just cannot interpret those two counties," so they are blind spots.

Now, the weather service office here could. I think you could very easily see a storm in Rutherford County or Polk County, but those two counties just across the state line are blind spots. Therefore, I can see the—by looking at Charlotte radar and Asheville I can see the severe weather there, but as we say we do not put out special weather statements, we only put out weather service statements, and I think we should continue to do that.

Ms. PATTERSON. Again, I am learning. Let me ask, Jack, something that you said in your statement I am not sure I understood—and maybe it is a question we need to ask Dr. Friday or Wayne later—you said something about now you have the capability of using the radar information on TV, and would you in fact have that same opportunity with NEXRAD.

Mr. ROPER. Well, you know, we have three, three and a half minutes or so, all our weathermen——

Ms. PATTERSON. Say everything.

Mr. ROPER [continuing]. To, you know, give our information on the nightly news, but I am saying as Ken does, I have the same thing, we can show you different radar sites as opposed to just Athens, Georgia that so much of our weather comes, you know, from the southwest. That is the one we really want obviously, but will we be able to have visual tie-in with this like through COVORES. Is that going to be years down the road? Will we be limited as broadcasters because, you know, on a night to night weathercast one picture is worth a thousand words—no offense to the newspaper—— but the thing I want to show first if it is raining is that radar unit. Are you going to take this away from me?

Mr. PRICE. Let us give Dr. Friday a chance to respond to that.

Ms. PATTERSON. Dr. Friday.

Mr. PRICE. Dr. Friday. Excuse me.

Dr. FRIDAY. The plans for the next generation weather radar include an access to any user of that radar. We are putting together—again, as I said earlier, everything has to have a name—we are putting together a NEXRAD information distribution system, so that every NEXRAD around the country will be accessible to the media much the way that the COVORES system works today. We anticipate having more than just simply, more than or two outlets for that. There will probably as many as four different companies around the country that will have access to all the NEXRAD data, will be able to make it available to the television market, to the media. We will also be able to make it available to other users that may have a reason to have that.

So we do, we are very much concerned about making sure that data is available to all users.

Mr. ROPER. Thank you.

Ms. PATTERSON. I just have one last—and, Lee, it really sort of goes to something that you had in Charlie's statement—by the way, tell Charlie—"Gentlemen of the committee"—tell him I was here, too.

Mr. BROWN. I will do that.

Ms. PATTERSON. I love to tease Charlie.

Something that you mentioned in—by the way, I think it is a tribute to our local weather station, Wayne, that everyone says how helpful you were at that time and how much involved you were—but there is something that was mentioned in this statement, and again I am learning, and I maybe need to turn to staff and get, but you did mention something in response to the request for operational changes you said improve the time lines of hazardous weather warnings, and then you mentioned headings on watch and warning messages are too long and cumbersome. Is that something that we can work with, or is that something that Dr. Friday and Wayne—?

Mr. BROWN. In most cases I think there is generally a—depending on the type of warning or watch that is issued there is a standard heading that they generally put on it, having read this for years as it comes across the wire, and many times at quick glance—and we are all in a very busy business, and even when we are confronted with severe weather situations you are trying to get that information as quickly as you can, and I have also expressed,

or have experienced some of Charlie's frustrations as he did put in his statement. When you are looking for the point of the statement sometimes it is very difficult at quick glance to see that without some detailed reading, and you realize sometimes when you get into one "Well, this is not for our area," then you will have to—and especially when like on the afternoon of May 5th there are a lot of continuous warnings that are coming out all afternoon, and assimilating all that information does get very difficult at times when there is so much listed in the heading to the statement itself before you get to the meat, "These counties are affected, it is a tornado warning," and then they generally put some advisory information that is, I think Mr. Jones pointed out earlier, is very useful information for the public, and we do include that as a matter of course, it is just when that is included each time it does get to be a very cumbersome thing to deal with.

Ms. PATTERSON. So you are saying the weather service is like a lot of other things and we have maybe too much paperwork, a little bit of bureaurarcy that maybe we could improve and make it move a little bit faster.

Mr. BROWN. Perhaps.

Ms. PATTERSON. Well, we will see if there is any way that we encourage that or work it.

Thank you. David?

Mr. PRICE. I am impressed with the testimony each of you have given about the cordial professional working relationship you have with the weather service office here. It seems to me that is a tribute to that office and to the kind of relationship that has been built up over the years.

I find less in your testimony, though, about the specific, your specific assessment of the situation on May 5th and the adequacy of the warnings you were able to give to your listeners. I think Mr. Roper's statement contains nothing about that, and the other two statements make only brief references.

Now, Mr. Bostic, you are the most specific. You do indicate that the warnings that were available left something to be desired. You suggest that the present network of radar systems is not giving adequate service to upstate South Carolina, western North Carolina. Of course, we do not have a radar system here right now, the closest one is in Athens, Georgia as I understand.

Mr. BOSTIC. That is correct.

Mr. PRICE. And you have some specific references in your statement to the new Dopler system, saying the present radar systems used in this part of the country are outdated, not equal to the new Dopler system.

Mr. Gertz's testimony which was submitted to us refers to the handicap the weather service operates under because of the lack of state-of-the-art equipment.

Now, I understand the concern about keeping the weather service office open here. Your testimony tell us less, though, about the adequacy of the warnings which you had on May 5th and that you have in general. Could you elaborate a bit on that?

Mr. BOSTIC. As I said earlier, I started following that particular storm pattern in Atlanta and watched it come across, and I too was getting concerned by just some of the pictures I was seeing. Howev-

er, I was having to deal not only with our TV station, but with a Greenville radio station at the same time, and trying to get the information to both of them at the same time.

One of the things that has improved our situation, and I think it has happened here in South Carolina, we have phased out the old weather wire service and now have gone on a new satellite receiving system from the weather stations, the Contel, and I was shocked at how fast we are getting those warnings. We are getting—the minute you put that warning on the air we are getting it instantly, just that fast, and we are getting them out there just as quick as possible, but again the interpretation of the radar is what slows some of that up.

Wayne made a good statement, there are times when Athens—I do not know if they are adjusting the level, but all of a sudden they will just sit on a signal for five, ten, fifteen, twenty minutes at a time, and if it is a critical period where you have got a big storm maybe crossing from one county to the other you are waiting on that new picture, you keep waiting and they are just sitting there, you do not know what they are up to. So the radar system is what slows us down as far as getting the warnings on the air.

The ability to get the warning to the public now has been made much faster with Contel and the new system we have. We can just, boom, get it—the minutes he says it we get it.

Mr. PRICE. But you are feeling the effects of the deficiencies of that 1950s radar, 1950s model radar?

Mr. BOSTIC. Absolutely. Absolutely. And it is not so much—I do not look at it so much as the deficiency of the radar as the fact that where they are located. You know, we are relying on pictures a hundred miles away from us. There is just nothing in this part of upstate South Carolina or western North Carolina. We have no radar sites.

They tried for a couple of years to get one at the Asheville airport, and Chattanooga wound up with it, Asheville lost out. So we are hurting just from the lack of having a radar system.

Yes, if you had one at the Asheville airport it would not be as effective because of the high terrain and the mountains there, you do get a lot of false readings.

Mr. PRICE. But I assure you that having a radar site right in your back yard does not guarantee an adequate warning either, as we can testify with great conviction from our Raleigh-Durham experience. There is the problem of where these sites are located, but there is also the question of what these sites at best can produce in the way of early warnings of these approaching storms.

Mr. BOSTIC. As I said, if I may make just one more comment, my biggest concern—and I do not know who sets up all these systems—is why you would not put a new radar site west of Raleigh, North Carolina near Charlotte, which is the biggest population center of the state, that would also work its way west. That does not make a bit of common sense to me at all.

Mr. PRICE. Well, I think it is a good question, and that is of course one of the reasons we are here today to explore that question.

Mr. Roper, I gather you are more skeptical of the need for NEXRAD and its potential. You described it as a potential Edsel. Could you elaborate on that?

Mr. ROPER. Well, there seems to be some—and I appreciate your honesty, Dr. Friday, but there seems to be some skepticism from you in what you are telling us. Again, I am walking away with some real concerns about the radar itself that I did not have before I got here.

Mr. PRICE. Can you elaborate on what those are?

Mr. ROPER. Well, the range I think was the main thing that concerned me there, and the fact that if indeed after touchdown of a tornado outside of 50 miles an hour how would we track it other than with the local spotters.

It seems to be a mechanism to see the formation within the clouds within immediately about 50 miles of the site—that seems to be the real bonus of the new radar. Is that the way I am to understand that? That seems to be the strong suit.

Mr. PRICE. I would like for Mr. Friday to have a chance to respond if that is all right, Madame Chairman.

Ms. PATTERSON. Sure.

Dr. FRIDAY. If I left the impression in my statements that I was concerned about the performance of the radar in comparison to systems that we have now, then I have been a very poor speaker. I certainly did not intend to do that.

As far as the range of the radar is concerned, the range of the radar is comparable to the present radars as far as being able to detect storms and so on, but it does that with a much better accuracy.

The beam width, for example, on the NEXRAD radar is half of that—actually a little less than half of the existing WSR 57s and 74Ss that we have. Therefore, you are going to be able to see with greater detail at greater distances the storm structure that we use now.

The fact that the tornado after it touches down will not—you are concerned about our ability to track that—we do not track the tornadoes now. We track the storms now. We will be able to track the storms now with greater accuracy and greater definitions with the new system than we were with the old.

The people that are using the current radar, or the Dopler radars now in Oklahoma, in Denver and so on are extremely pleased, the meteorologists there are very happy with the performance of the radar as far as being able to track the storms that are of concern, so if I misled you along that line I certainly did not intend to do so.

The radar that we are talking about in every respect is better than the existing systems.

Mr. ROPER. May I address the gentleman just one quick comment here?

What you are saying about the new system is fine except you told us earlier one would be implemented in Columbia, and when you look at that range—that is south of us, our storms generally come out of the west from Atlanta and Tennessee and those areas, so where would another one be that would—see, we do not want to look down at Columbia and see what is going on, we want to look

to the west and see where it is coming—would there be one in Athens?

Dr. FRIDAY. Atlanta.

Mr. ROPER. Atlanta. Okay. Now, see, again we are 120, 130, 140 miles away from Atlanta, so once again we are not going to have a good, solid weather picture to look at. We are not going to see what is going on in northeast Georgia or eastern Tennessee.

Mr. PRICE. How far away is Athens?

Mr. ROPER. Almost a hundred miles. A hundred miles, I guess.

Mr. PRICE. And your main reliance now is on the Athens radar?

Mr. ROPER. That is correct.

Mr. PRICE. And Atlanta is how much further away?

Mr. ROPER. A hundred and forty or fifty from here, probably. I do not know about the airport, but the city of Atlanta is about 140 or 150.

Mr. PRICE. I know we have other panelists that we need to get to. I appreciate the appearance of these meteorologists and the testimony you have given us.

Thank you.

Ms. PATTERSON. Thank you, gentlemen, very, very much.

We will move on to the next panel and if everyone else in the audience just wants to stand and just take sort of a seventh inning stretch—I know you have been sitting a while—while they are coming forward. If you would like to do that, we will have a few minutes.

[Pause.]

Ms. PATTERSON. The hearing is supposed to end at 12:30, and I know there are lots of interested people still to appear.

Let me say after earlier today when I asked people to stand up who represented different organizations, I believe after that time members of the Spartanburg County Delegation came in, and the Spartanburg County Sheriff. I do not know if any of them are still here, but I am sorry you were not here when I recognized folks earlier. We are glad to have you.

As Congressman Price and Congressman Valentine said, they do have a plane to catch, and we know that our planes leaving from Greenville-Spartanburg Airport always leave on time——[Laughter.]

Ms. PATTERSON [continuing]. So we want to get them out there in plenty of time.

We will begin this third panel. Again, we appreciate all you who are here to listen and help us make some important decisions.

This is our local government officials panel. As you all can probably tell, we have combined the local governments with the emergency preparedness offices knowing that they were so much a part of that time.

We will begin this morning and hear from Jim Miles who is a councilman for the City of Greenville and will be speaking for the City of Greenville.

STATEMENTS OF JAMES M. MILES, COUNCILMAN, CITY OF GREENVILLE, SC; SHIRLEY S. HILL, DIRECTOR OF EMERGENCY PREPAREDNESS, SPARTANBURG, SC; MICHAEL B. PHILLIPS, DIRECTOR OF EMERGENCY PREPAREDNESS, GREENVILLE COUNTY, SC; JIMMY WILKINS, DIRECTOR OF EMERGENCY PREPAREDNESS, UNION COUNTY, SC; AND L. WAYNE BROOME, DIRECTOR, CHARLOTTE-MECKLENBURG EMERGENCY MANAGEMENT OFFICE, CHARLOTTE, NC

Mr. MILES. Thank you.

I want to thank you for having this hearing here in Spartanburg, Congresswoman Patterson. I understand you all are in recess. Is that right?

Ms. PATTERSON. We are in——

Mr. MILES. Well, your work never ceases.

Ms. PATTERSON. Right.

Mr. MILES. I am here on behalf of the City of Greenville and representing the mayor, and I guess that I could sum up my sentiments by echoing what Jack Roper said.

I am more concerned now than I was before I came, and I have studied the information and the report and the proposal, and for the life of me—and I have prepared a written statement that I am going to deviate from if that suits you——

Ms. PATTERSON. If you will just present it for the record.

Mr. MILES. It has been presented, has it not?

Ms. PATTERSON. Okay.

Mr. MILES. For the life me of, I cannot imagine having the radar station put in Columbia whenever the effective range of that according to the report that I had is not forty, fifty or sixty miles, instead it is more like thirty miles. And then as it beams on out you virtually get no coverage from 10,000 feet on down to the ground.

We are living here in the upstate, and for the information of you, Dr. Friday, one-third of all the people who live in the state of South Carolina live here in the upstate. This is a boom area, an area that is highly industrialized, growing, a big farming industry. Maybe you can partake of some of our peaches before you leave.

But I would hope that Congress would examine this very carefully and use some common sense. Having weather south of us and to the east of us from Raleigh and leaving us I think very vulnerable simply does not make sense, and I would ask you, respectfully ask you to look at placing one of these modernization programs here in the upstate.

We are all in favor of modernization, and again as I read the information that has been presented I frankly think that what you are trying to do is laudable, and I commend you for it, and I also think saving tax dollars is laudable, I ran my campaign on that basis, but saving tax dollars and losing lives and having increased property damage, no warnings, does not make sense.

So again we would respectfully request that you study this very carefully as it relates to upstate South Carolina.

Thank you.

[The prepared statement of Mr. Miles follows:]

STATEMENT IN SUPPORT OF RETAINING THE WEATHER SERVICE OFFICE AT THE GREENVILLE/SPARTANBURG, SOUTH CAROLINA AIRPORT

Presented By

MR. JAMES MILES, MEMBER OF CITY COUNCIL
GREENVILLE, SOUTH CAROLINA

INTRODUCTION:

Mr. Chairman, ladies, and gentlemen my name for the record is James M. Miles and I reside at 147 Marshall Bridge Road, Greenville, SC. I am speaking on behalf of the Mayor and members of City Council, Greenville, South Carolina.

We appreciate the opportunity given us to appear before this committee in support of retaining the weather station located at the Greenville/Spartanburg Airport.

Greenville, SC is a part of the upstate area serviced by this weather station as is Greenville County, Spartanburg County, Greenwood, Oconee, Pickens, Laurens, and Cherokee County. The Greenville/Spartanburg/Pickens SMSA population exceeds 630,000 people making it the largest in the state.

The Greenville/Spartanburg area is an important center of commerce which enjoys excellent economic growth. We enjoy a diversity of industrial development, business and industry, as well as a substantial farming industry. It should be further pointed out that one-third of the state's population lives within the upstate area serviced by the Greenville/Spartanburg Weather Station.

CONTENTION:

Ladies and gentlemen, we have carefully studied the proposal entitled "The Strategic Plan for Modernization & Associated Restructuring of the National Weather Service." Certainly we do not oppose progress nor modernization of the nation's weather stations. We believe that adequate qualified personnel should be provided as well as upgraded technology to the maximum extent. It is our contention however that plans to eliminate certain weather stations and more particularly the Greenville/Spartanburg Weather Station does not make sense. On the contrary, the weather station should be expanded and upgraded to meet the needs of a growing and developing upstate area.

JUSTIFICATION:

Ladies and gentlemen not only have we studied the National Weather Services' proposal but we have studied other relevant materials as well. We believe certain items of justification should be listed:

1. The National Weather Service Employee Organization (NWSEO) has prepared a comprehensive document addressing each major point presented in the National Weather Services proposal. We believe this document to be well done and substantiates many of our concerns. For example, of major consequence is the proposed Dobler radar system. We do not believe that the Dobler radar is proven to date. The NWSEO's report substantiates this fact in our opinion. The National Weather Service's proposal is highly dependent upon this radar system. Time does not permit us to go into each point presented by the NWSEO however we wish to include their report as part of our written justification.

2. We are aware that previous efforts have been made to justify further enhancements to the Greenville/ Spartanburg weather station. We include as a portion of our documentation reference to this request presented on behalf of Clemson Unversity and expressing a willingness by Clemson University to fund and operate a weather radar station in conjunction with the Greenville/Spartanburg Weather Station. We believe this proposal has merit and should at least be given consideration in support of retaining our local weather station.

3. The recent newspaper articles written by staff writer Mr. Ed Martin quoted both the Mecklenburg Emergency Management Director and the meterologist for WLOS-TV as having major concerns with the proposed National Weather Service modernization plan. The accompanying map clearly indicates the vulnerability and lack of coverage provided to the Greenville/Spartanburg area as well as the Charlotte, NC area. Discussions with Mr. Ray Boylan indicates to us that he has sound reasons for his statements. We would concur.

4. We do not believe that coverage by a proposed station even though it may be upgraded and located one-hundred (100) miles away can possibly provide the local attention needed and presently offered by the Greenville/Spartanburg Weather Station. The system of local spotters, volunteer Ham operators, and the technical employees are surely sound justifications for retaining the weather station located at the Greenville/Spartanburg airport.

5. We realize that the proposed plan to modernize the National Weather Service is in part designed to save tax dollars. This is in our opinion a misconception if the results lead to a loss of life and substantial property damage in our area and particularly when this loss need not occur.

SUMMARY:

In summary we are suggesting that:

1. The National Weather Service proposal does not provide sufficient documentation to convince us that our local Greenville/Spartanburg Weather Station could be eliminated without having a tremendous, detrimental impact on the upstate of South Carolina.

2. Other options such as upgrading the Greenville/Spartanburg Weather Station utilizing Clemson University's assistance has not been properly considered.

3. The major component of the Dobler radar has been oversold to the public and will not perform as anticipated.

4. The new restructuring and locations of proposed weather stations does not provide adequate geographic coverage.

RECOMMENDED ACTION:

We are asking that the proposed National Weather Service plan be reconsidered and that the Greenville Spartanburg Weather Station remain intact. Furthermore we suggest that the Greenville/Spartanburg Weather Station be considered for further enhancements. We do not wish to endorse any plan which would lead us toward the loss of lives and increase property damages within our area. We appreciate the opportunity of having addressed this committee on behalf of the City of Greenville and the upstate area.

Respectfully,

_____

James M. Miles, Councilman
Greenville City Council

Enclosures:
1. Strategic Plan - National Weather Service
2. Response to the Stategic Plan - NWSEO
3. A proposal for the South Carolina upstate
4. Assorted newspaper accounts

JB:bw

R728

STRATEGIC PLAN FOR THE MODERNIZATION AND ASSOCIATED RESTRUCTURING OF THE NATIONAL WEATHER SERVICE

Department of Commerce

National Oceanic and Atmospheric Administration

March 1989

Table of Contents

INTRODUCTION 1

PRINCIPLES FOR THE MODERNIZATION AND ASSOCIATED RESTRUCTURING 2

THE NEED TO IMPLEMENT NEW SCIENCE AND TECHNOLOGY 3

THE TECHNOLOGICAL OPPORTUNITY 4

MAJOR TECHNOLOGIES FOR MODERNIZATION 4

THE NEED TO RESTRUCTURE 7

THE NATIONAL WEATHER SERVICE IN THE 1990s 9

THE WEATHER FORECAST OFFICE (WFO) AREA OF RESPONSIBILITY 9

INTEGRATED OPERATIONS WITHIN THE WFO 9

THE NEW STRUCTURE 11

STAFFING 14

IMPLEMENTATION 16

TRANSITION PLANNING 16

DEMONSTRATION AND CERTIFICATION 17

IMPLEMENTATION SCHEDULE 18

EXPERIMENTAL SYSTEMS 19

PRODUCTIVITY AND EFFICIENCY ADVANTAGES 20

MEETING THE CHALLENGE OF THE 1990s 21

INTRODUCTION

Weather pervades and affects the daily life of each American. Since the beginning of the Republic, a strong scientific tradition of meteorological research and service has existed in the United States. At a national, regional, and local scale, weather affects the Nation's agriculture, water resources, transportation, general economy, and public safety. Accurate information about future atmospheric events is key to mitigating any adverse effects of the weather. Federal agencies have long joined in cooperative efforts to collect, share and effectively use weather data and information for the public good. Applied research conducted over the last ten years in the National Oceanic and Atmospheric Administration's (NOAA) Environmental Research Laboratories in New Jersey, Colorado and Oklahoma, and other Federal laboratories such as the National Center for Atmospheric Research has demonstrated that state-of-the-art laboratory techniques for analyzing and predicting severe weather and flood phenomena can be practicably applied to Weather Service operations. Because the scientific understanding of the atmosphere and the ability to forecast large and small-scale weather phenomena has increased dramatically over the last two decades, the Department of Commerce has set an ambitious goal for the National Oceanic and Atmospheric Administration's agency, the National Weather Service (NWS):

To modernize the NWS through the deployment of proven observational, information processing and communications technologies, and to establish an associated cost effective operational structure. The modernization and associated restructuring of NWS shall assure that the major advances which have been made in our ability to observe and understand the atmosphere are applied to the practical problems of providing weather and hydrologic services to the Nation.

Implementation and practice of the new science will achieve more uniform weather services across the Nation, improve forecasts, provide more reliable detection and prediction of severe weather and flooding, permit a more cost effective NWS, and achieve higher productivity for NWS employees. The effort to improve weather warnings and forecasts will be guided by the principle of providing high quality weather services to users while concurrently lowering NWS operating costs. The development of new technologies will be guided by the principle of balancing technical and service improvements with overall costs. All changes proposed by the NWS will allow productivity and efficiency for any entity dependent on weather information. This includes local, state, and Federal government agencies, private sector meteorologists, private industry, and resource management organizations.

In 1988, Public Law 100-685 was signed by the President which, in part, specifies conditions on the planning, reporting and accomplishment of the modernization and associated restructuring of the NWS. This Strategic Plan is the first response to the Congress required by Public Law 100-685. The Federal law requires an identification of the basic service improvement objectives of the modernization, the pivotal new technological components, and the associated operational changes required to fulfill the objectives of weather and flood warning improvements. Plans, resources, schedules, etc. will be contained in the second, and subsequently annual report required by the Congress -- the National Implementation Plan.

PRINCIPLES FOR THE MODERNIZATION AND ASSOCIATED RESTRUCTURING

The Modernization and Associated Restructuring goal will require significant changes in the current weather service infrastructure and operations. Accordingly, the following principles will guide the planning and implementation.

Throughout the process of change, the NWS is committed to its Mission which is *to provide weather and flood warnings, public forecasts and advisories for all of the United States, its territories, adjacent waters and ocean areas, primarily for the protection of life and property. NWS data and products are provided to private meteorologists for the provision of all specialized services.* The following principles are essential to meet the operational mission and will be continued during the modernization and associated restructuring transition period.

The principle that the modernization and associated restructuring process will not result in the degradation of services to the general public. Also, service and structural changes and improvements will be implemented only when certified in accordance with Public Law 100-685 to be beneficial to users.

The principle that NWS employees will be involved because their participation is crucial to a successful transition and improved operations. Significant levels of training and education will be provided so that employees will gain the necessary expertise to utilize the new technologies, understand the new sciences underpinning the modernization and associated restructuring and provide the improved services to the Nation. The changes will provide exciting opportunities for professional growth.

The principle that United States international meteorological and hydrologic obligations will be met during and after the modernization and associated restructuring. The exchange of global atmospheric data is essential to the successful interpretation and forecast of weather phenomena in the United States. The NWS is a partner supporting national security interests on a global basis.

The principle that NWS employees will continue to provide the quality weather services required by the country in the most economical manner.

THE NEED TO IMPLEMENT NEW SCIENCE AND TECHNOLOGY

A weather service organization, whether private or public, fulfills fundamental public safety and economic needs. The information provided supports life-saving and economic productivity decisions. For example, hurricane evacuation recommendations and airline routing decisions are heavily dependent on weather forecasts. As a Nation, the United States experiences more severe local storms and flooding than any other in the world. Eighty-five percent of all presidentially declared disasters result from severe weather events. In a typical year, the United States can expect a staggering assault by the elements: some 10,000 violent thunderstorms, 5,000 floods, 1,000 tornados, and several hurricanes. Along with periods of severe drought, hard winters, and heat waves, these events translate into considerable loss of life and annual property damages estimated in billions of dollars.

The most deadly of our Nation's weather events -- tornados, severe thunderstorms, and flash floods -- are also the most difficult to detect and forecast. They form and exist at the small atmospheric scale (mesoscale) and are measured in minutes and tens of miles. Most mesoscale phenomena are well below the operational resolution of routine observations and analysis today. However, prototype observing technologies and information processing systems, when made available to research meteorologists have provided the first observations of, and insights into the formative indicators of dynamic mesoscale processes of the atmosphere. When implemented operationally, these systems and associated science will improve all weather forecasts provided by national meteorological centers and weather forecast offices. These new systems will enable earlier detection and permit the short range prediction of destructive, violent, local storms and floods, thereby mitigating a glaring shortfall in current warning services. The new observational technologies planned for the next decade will provide unprecedented amounts of complex information and data, requiring significantly higher levels of analytical and interpretive skills by the operational forecasters.

To realize the gains from this research and technology, the Nation needs to put the new meteorological science into practice. This will require training personnel and the deployment of proven, new observational, information processing, and communications technologies.

At present, the vintage technologies that compose part of today's weather service infrastructure need to be replaced. As the equipment has aged, it has become costly to maintain. By replacing the equipment with more reliable technologies that support the new scientific capabilities, the Nation can move into the twenty-first century with strengthened confidence in its atmospheric prediction capabilities.

THE TECHNOLOGICAL OPPORTUNITY

MAJOR TECHNOLOGIES FOR MODERNIZATION

New technological systems are essential in providing the opportunity to improve warning and forecast services and for replacing obsolete and increasingly unreliable existing systems. Each of the new technologies plays a unique, but complementary role in the modernization process. The information provided by the new observational technologies will yield high resolution, time variant, three-dimensional representations of details on the state of the atmosphere. At Weather Forecast Offices, intended to perform warning and forecast services, advanced weather data processing systems will aid the forecaster in the assimilation of changing data and numerical weather prediction products. The meteorologist and hydrologist will be able to rapidly manipulate, display and analyze information, thus enabling them to combine scientific principles and operational experience to produce more accurate and timely warning and forecast services for the Nation. The new high resolution data sets and derived information are an important input to business and economic decision making outside the NWS.

Numerous Federal agencies have long shared in the observation and exchange of hydrometeorological data. The existing national observing networks are sparse and limited in their coverage of the Nation's atmosphere. The NWS is joined in its acquisition of much of the major new technologies by the Department of Transportation's Federal Aviation Administration and the Department of Defense, which results in economies of scale and a reduction in purchase costs. The geographical placement of the new radars and automated surface observing systems is coordinated by the three agencies thereby providing more uniform national coverage by these land-based systems. The new geostationary meteorological satellites being procured by NOAA complement the new radars and automated surface observing systems with blanket coverage of the conterminous states. Data from these new observing systems will be shared by each participating agency and will be available in summary form throughout the Nation.

Automated Surface Observing System (ASOS)

Automating surface observations will relieve staff from the manual collection of surface observations. Over 1000 ASOS systems across the Nation will be providing data on pressure, temperature, wind direction and speed, runway visibility, cloud ceiling heights, and type and intensity of precipitation on a nearly continuous basis. The 1000 ASOS sites include approximately 750 airport installations under the jurisdiction of the Federal Aviation Administration and approximately 250 NWS sites. The Department of Defense is also considering the acquisition of additional units. The observational data provided by the ASOS system supports aviation operations and provides meteorological data needed by severe weather, flash flood, and river flood forecasting programs. The national capability to observe and transmit critical changing weather conditions almost as they occur represents an important enhancement for improving warning and forecast services.

Next Generation Weather Radars (NEXRAD)

Utilizing Doppler radar technology, the NEXRAD system will observe the presence and calculate the speed and direction of motion of severe weather elements such as tornados and violent thunderstorms. NEXRAD will also provide quantitative area precipitation measurements so important in hydrologic forecasting of potential flooding. The severe weather and motion detection capabilities offered by NEXRAD will contribute toward an increase in the accuracy and timeliness of NWS warning services. At present, for example, due to the limitation in the current radar detection systems, tornado warnings are usually issued only when visual sightings have been reported. The advent of NEXRAD will not only allow for an earlier detection of the precursors to tornadic activity, but will also provide data on the direction and speed of tornado cells once they form. The national network of 160 NEXRAD systems provides a significant improvement in uniform coverage over the present day radar network. The NWS plans to operate 121 NEXRAD systems; the remainder of the NEXRAD systems will be located at Federal Aviation Administration and Department of Defense locations.

Satellite Upgrades

For severe weather and flood warnings and short range forecasts, cloud imagery and atmospheric sounding data from the geostationary meteorological satellites will continue to be a major data source. The new Geostationary Operational Environmental Satellite (GOES) I-M system will have separate instrumentation that allows simultaneous image and sounding data to be observed and transmitted to ground stations. The GOES I-M system will also provide visible and infrared imagery data updates as frequently as every six minutes during severe weather warning situations over selected areas of the United States.

For longer-range forecasting, soundings from the polar orbiting satellites are a primary data input into the National Meteorological Center numerical forecast models. The Advanced Microwave Sounding Unit, to be flown on the NOAA K-M satellite series, will provide global soundings in cloudy regions at nearly the same level of accuracy as those presently produced in cloud free areas.

National Center Advanced Computer Systems

Warnings and forecasts prepared by NWS offices in the next decade will rely heavily on the basic analyses and guidance products provided by the National Meteorological Center, especially for periods of 36 hours and beyond. These analyses and guidance products result from numerical models of the atmosphere run on high-speed computers. The future requirement for guidance products for mesoscale warnings and forecasts is greatly increased over the present. Fundamental model improvements are necessary to satisfy these requirements and provide guidance products of sufficient quality and frequency to support the warning and forecast operation at each office. Present day Class VI computers do not possess sufficient capacity to support the improvements needed at the National Centers. These increased demands require the acquisition of dedicated next generation Class VII computer capabilities with a processing capability an order of magnitude greater than the present Class VI computer.

Advanced Weather Interactive Processing System (AWIPS)

The revised AWIPS system will be the nerve center of the operations. AWIPS will be the data integrator receiving the high-resolution data from the observation systems, the centrally collected data and the centrally prepared analysis and guidance products from the National Meteorological Center. The integration of all of this data from multiple sources represents the information base from which all warning and forecast products will be prepared. The AWIPS system will provide fast-response interactive analysis and display of the data to help support the meteorologist make rapid decisions, prepare warnings and forecasts, and disseminate products to users.

AWIPS includes the communications network that inter-connects each Weather Forecast Office for exchange of locally generated data. NOAAPORT will provide communications support for the operational distribution of the centrally collected data and centrally produced analysis and guidance products, as well as the satellite imagery and sounding data processed by the National Environmental Satellite, Data and Information Service. In addition to supporting the requirement for AWIPS point to multi-point communications, NOAAPORT will also deliver a wide range of NOAA products, such as oceanographic and environmental data to external users including other government agencies, universities, private research organizations, and business interests.

THE NEED TO RESTRUCTURE

The planned restructuring involves changing the number and location of field offices in a manner responsive to certification conditions imposed by Public Law 100-685, a gradual transformation of the workforce to one more professional in its makeup, and a reallocation of operational responsibilities between field offices and the National Centers.

The effective use of the advanced technologies planned for the NWS is closely linked to the scientific abilities of NWS personnel and the national field office structure. The current field office structure has evolved intermittently throughout the agency's history. Today, the structure supports a labor intensive observation and dissemination network. If the new technological network were constrained by the current field office structure, required staffing levels and overall costs would increase unnecessarily.

The need to restructure is twofold: first, the combination of new operational concepts, new data sets, and an evolving scientific understanding of the dynamic processes associated with the most dangerous weather phenomena requires an increase in the number of meteorologists. During periods of impending severe weather and flooding, operational personnel are under extreme pressure to make timely and accurate decisions. The percentage increase of meteorologists in the NWS workforce will improve warnings and forecasts by taking advantage of the capabilities of the new technologies. Second, productivity and efficiency gains will occur as a result of increased integration of the new technological observation, information processing and communication systems with the staff. An increased effective range of the radar systems and the ability to assemble all data at a reduced number of offices increases productivity and efficiency. The reduced number of offices places a special emphasis on the effective delivery of weather services to communities.

Key tradeoffs in the restructuring process exist between human capabilities, costs, and programmatic, scientific, and technological opportunities. Factors considered in determining restructuring and ultimately the quality of warning and forecast services include the ability to establish a more uniform observational network across the country, the automation of observational duties, orographic (effects of mountains) characteristics, the ability of the NWS workforce to employ and understand new technologies and science, and so on.

DEPICTION OF THE TOTAL COVERAGE (AT 10,000 FT ELEVATION) PROVIDED BY THE COMPLETED NATIONAL NEXRAD NETWORK.

DARKENED AREAS OVER THE ROCKY MOUNTAINS ARE GAPS IN COVERAGE AT THE 10,000 FT LEVEL. NEXRAD COVERAGE WILL ALSO BE PROVIDED IN ALASKA.

THE NATIONAL WEATHER SERVICE IN THE 1990s

THE WEATHER FORECAST OFFICE (WFO) AREA OF RESPONSIBILITY

A conceptual analogy of the area of responsibility of a WFO can be portrayed as follows: on the surface of a map of the United States consider a uniform arrangement of 115 conterminous cylinders, each with a radius of approximately 125 miles, extending from the earth's surface up through the atmosphere. The volume of space contained within each cylinder represents the "area" of operational responsibility associated with the WFO. A WFO is located in the center of the base of the cylinder. Each section of the country and the coastal ocean is contained in one of these cylinders and the whole of the country is theoretically uniformly covered.

The GOES Satellite positioned over the United States is providing uniform coverage with visible and infrared imagery and remote soundings penetrating each cylinder from above. Associated with each WFO is one or more NEXRAD radars which scan the atmosphere from near the earth's surface to a height sufficient to detect the majority of meteorological events. Across the surface of the country are the approximately 1000 ASOS units each measuring surface weather parameters as fast as every minute. All of these data within the cylinder are sent directly to the AWIPS system in each WFO. The AWIPS is also receiving the centrally produced guidance products from the National Centers generated from globally exchanged data. Subsets of these data sets are available to all other WFOs through the AWIPS communication network.

INTEGRATED OPERATIONS WITHIN THE WFO

The future operations will allow forecasters to comprehensively address the air-sea environment in their assigned area. The observation and analysis of current and expected weather conditions can be quickly and reliably completed, critical decisions made, and translated into immediate warnings and forecasts. This is contrasted to current operations where a number of meteorologists and technicians are required to individually evaluate a limited data base and separately derive the required variety of warnings and forecasts.

LOCATIONS OF THE WEATHER FORECAST OFFICES

The concept of the local data base is central to future operations. The high volume of data from the local NEXRAD and geostationary meteorological satellites combined with the high frequency observations from ASOS will flow directly to the Weather Forecast Office. The most complete data sets will only be available to the local WFO. However, summarized data from all NEXRADs and ASOSs in the Nation will be made available to all field offices.

The new observing systems are designed to provide data sets which can be immediately integrated into three dimensional depictions of the rapidly changing state of the environment. Each system will contribute a critical part, combining with and complementing data from all other systems to form a complete set of information about the space from the earth's surface to the upper atmosphere over the WFO's area of responsibility. AWIPS work stations will allow the forecaster to quickly update, quality control, and analyze current processes and events detailed within the area of concern. New dedicated supercomputer capabilities and high resolution models running at the National Centers will provide a stream of detailed, frequently updated guidance to forecasters, assisting in the prediction of future conditions. This represents a new, highly integrated mode of operation which greatly increases the productivity of personnel, and also holds the promise of increased accuracy and greater timeliness of forecast services for the Nation.

THE NEW STRUCTURE

The WFO will be the future weather office that will provide all warning and forecast services for its assigned area of responsibility. The forecast and warnings operations at the WFO are supported by guidance products issued from the National Centers and RFCs.

Weather Forecast Offices (WFOs)

A total of 115 WFOs will exist in the future that will provide weather and hydrologic services in four major areas:

- Watches and warnings for the general public for severe local storms, floods, flash floods and winter storms. Local and zone public forecasts, and fire weather forecasts;
- Local aviation watches and warnings, terminal forecasts, and domestic aviation enroute forecasts;
- Marine warnings and forecasts for coastal areas of the Nation and the Great Lakes; and

- Hydrologic services which identify flash flood-prone areas and the development of community supported surveillance systems.

The foundation for the more accurate and timely warnings and forecasts will be the guidance products from the National Centers and RFCs and the data from the new observing systems: ASOS, NEXRAD and geostationary meteorological satellites. They will provide the unique local data base which depicts the environment in the WFO's area of responsibility.

The basic tool for more accurate and timely warnings and forecasts from the WFO is AWIPS. It will assemble, process and display the observational data and guidance from National Centers. AWIPS will help meteorologists with the warning and forecast decision process through an interactive work station. It will preformat warning and forecast products and disseminate these products to the users in a timely manner.

River Forecast Centers (RFCs)

RFCs provide hydrologic forecasts and guidance information in three major categories:

- Mainstem river and flood forecasts for conditions at approximately 3000 locations with lead times ranging from six hours to several days;

- Flash flood and headwater guidance to WFOs for warning services involving small drainage basins with response times under six hours; and

- Long-term, seasonal forecasts providing estimates of snowmelt and water supply outlooks (from excess to drought) at approximately 1000 locations for periods up to several months in advance.

In the 1990s, the operations of RFCs are expected to change in a number of important ways. Each of the 13 RFCs will be colocated with a WFO. This will result in a more effective utilization of hydrological and meteorological information facilitated by a Hydrologic Analysis and Support Group in each colocated facility. It will also result in cost savings through shared facilities and through on-site exchange of data and information. Flash flood procedures will be more sophisticated resulting in more frequent updates of guidance and information for use by WFOs.

The basic river and flood forecasts produced by the RFC for specific locations along mainstem rivers are sent to WFOs as a basis for flood warnings to the public. Historically, RFCs have operated on one forecast cycle per day, based upon manual observations taken early each morning. To keep pace with changing weather and soil moisture conditions, assimilated data from automated data collection networks and NEXRAD, and to provide quality control, RFCs will operate an average of 16 hours-per-day. RFC operations will expand to 24 hours during periods of flood threat and with seasonal

peak work loads. RFCs will produce hydrologic forecasts as frequently as every six hours, based upon additional data and improved forecast procedures. AWIPS will assist hydrologists in the RFCs through data collection and processing, hydrological model execution, product formatting, and product dissemination.

National Meteorological Center

The National Meteorological Center has the responsibility for national and international data collection. This data base is first employed for global atmospheric and oceanic analysis. The resultant analysis products are distributed to international and domestic users which include the NWS, other government agencies, and private sector meteorologists. The data base is then used as initial input to global atmospheric numerical models. These models produce international aviation forecast products, high seas forecast products, long range national forecast, and forecast guidance for local WFOs and RFCs. New dedicated Class VII computer capabilities will enable increases in the resolution of the models resulting in improved forecast products and guidance. Traditionally the long range national forecasts have begun at 3-4 days and beyond. The new computers will reduce this threshold to beyond 36 hours. This will allow local forecasters to devote their attention to short-term weather events that are not amenable to centralized model solutions.

Climate Analysis Center

The Climate Analysis Center is a specialized center established in support of the National Climate Program Act. The Climate Analysis Center is part of the National Meteorological Center and is colocated with it to take advantage of the data, computers, and scientific expertise available there. The Climate Analysis Center's responsibilities are national and international in scope, related to overall goals of the United States Climate Program and are not directly affected by the NWS field reorganization. The Climate Analysis Center collects, organizes and disseminates climate information for diagnosis of short-term climate change; conducts and supports research on the physical cause of short-term (monthly, seasonal and interannual) climate change; and issues forecasts of weekly, monthly, and seasonal departures of average weather conditions from climatological means.

National Hurricane Center

The National Hurricane Center will continue to be responsible for the analysis, prediction, and tracking of tropical weather systems, their development into tropical storms and hurricanes, and larger scale disaster preparedness and coordination. Geostationary meteorological satellites will track and monitor tropical storms 24 hours-per-day throughout their entire life cycle. Coastal NEXRADs will provide the opportunity to examine tropical storms and hurricanes as they approach land, to an extent never

before possible. New dedicated Class VII computer capabilities located at the National Meteorological Center will run new hurricane models which will provide improved hurricane forecast guidance to highly specialized tropical and hurricane forecasters located at the National Hurricane Center. AWIPS at the National Hurricane Center will integrate data, improve storm identification and tracking, improve dissemination of vital information to the NWS and external users, and allow more efficient use of personnel.

National Severe Storms Forecast Center

In the 1990s, the National Severe Storms Forecast Center will provide national severe weather guidance to WFOs and RFCs. It will issue more timely and specific mesoscale guidance necessary to support the severe weather and flood warning activities of the WFOs. It will develop new guidance products based upon National Meteorological Center mesoscale model output and new mesoscale data. It will continue to produce special hazardous weather forecasts and forecast guidance for domestic aviation users under interagency agreement with the Federal Aviation Administration. All of these activities depend on the new observing systems (NEXRAD, ASOS and geostationary meteorological satellites), on AWIPS, and on the improved guidance from the National Meteorological Center Class VII computer capabilities.

National Data Buoy Center

The National Data Buoy Center will continue the operation of deep sea, coastal buoys, and headland systems. Data from these buoys and these coastal systems are essential to marine warnings and forecasts, and numerical weather predictions.

STAFFING

The new observing and data processing and display systems will provide forecasters the opportunity to sample, observe, and analyze the environment to an extent never before possible. The related expansion of the sciences of meteorology and hydrology will directly translate into improved service capability while simultaneously allowing greater efficiencies. Future field offices will have a core staff of professional scientists at each WFO and RFC to take advantage of these new capabilities. These individuals will be charged to provide all warning and forecast services across their area of responsibility. They will meet these tasks with the ability to evaluate vast amounts of integrated data, analyze the processes and events which will affect their area, and apply their scientific and technical expertise in a broad spectrum of immediate decisions. These will translate into a flow of service products, warnings, forecasts and advisories, that will be based on, and contain increased detail for all parts of the area.

Meteorological technicians will require different skills to support the new technologies, and more demanding, and increasingly sophisticated operations. System maintenance requirements will also place increased demands on electronic technicians who will require advanced training to support and maintain a variety of complex equipment.

A Meteorologist-in-Charge will have responsibility for each WFO. WFOs will operate 24 hours-per-day. The staffing level will be determined by peak service demands and maximum weather activity, with reduced staff requirements at selected offices during hours of lower threat and service demands. The support staff in each WFO will include positions providing critical program and maintenance support to ensure efficient operations and for the practice of advanced applied science. The public hydrologic warning, forecast and information programs of each WFO will be managed and supported by Service Hydrologists strategically located at selected WFOs throughout the Nation. At each of the 13 colocated WFO/RFC facilities, a Hydrologist-in-Charge will have responsibility for the RFC, including the Hydrometeorological Analysis and Support Group. Hydrologists and hydrometeorologists will maintain non-real-time operational support functions, as well as provide hydrometeorological support to the multiple WFOs within the RFC's area of responsibility. Staffing levels at the RFCs will be sufficient to maintain forecast services, nominally 16 hours-per-day, with variations attuned to each RFC's hydro-climatology and seasonal distribution of flood threats.

IMPLEMENTATION

The NWS has never undertaken a systematic modernization and associated restructuring effort of the magnitude presented in this Strategic Plan. Accomplishing the transition from today's operation to the modernized and restructured NWS of the 1990s, without disrupting ongoing services, will be a complicated process. Application of the new science, enhancement of the workforce, deployment of the new technology, and restructuring of field offices will mean that virtually every NWS activity will change in some way during the next eight years.

Management of this transition will be a complex effort, involving every level of the NWS. Accordingly, the NWS has established a Transition Program Office to provide an organizational focus for the entire transition process. The Transition Program Office will draw upon the technical staff resources of the NWS Headquarters, regional offices and field stations to prepare the plans necessary for the NWS modernization and associated restructuring. Once these plans are prepared, the Transition Program Office will manage the implementation.

TRANSITION PLANNING

Transition plans will be placed in a tiered structure, with the Strategic Plan as the top level plan. The second tier, the National Implementation Plan, will be a broad guidance document supported by more detailed transition planning and implementation activities carried on throughout the entire agency. The National Implementation Plan will provide a planning framework and general strategies for accomplishing the transition, and establish basic transition management principles that will be used throughout the entire transition period in fulfilling the fundamental goals and objectives in the Strategic Plan. The National Implementation Plan will be updated annually and used to provide the Executive Branch, Congress, cooperating agencies, users, and the public with an overview of what modernization and associated restructuring is, how and when NWS will accomplish the transition, and progress reports on implementation.

The third planning tier, the Regional Transition Plans, will provide management flexibility and recognize both the decentralized nature of the agency's and the NWS Regions' responsibility to maintain ongoing operations throughout the transition period. These plans, intended for internal use, will set a course that will ultimately

achieve the modernization and associated restructuring goals and objectives within each Region, while taking into account unique conditions at each site, such as weather variations and user needs. Each Regional office will have the lead responsibility for preparation of their Regional Transition Plan, consistent with national policy.

The final planning tier, Site Implementation Plans, will contain specific, detailed actions and schedules for accomplishment. A separate Site Implementation Plan will be prepared for each WFO or WFO/RFC, and will address transition of all sites in its area of responsibility. Each Regional office will be responsible for the development and integration of Site Implementation Plans, with the support of the area managers.

The changes in operations and services related to modernization and associated restructuring will ultimately guide the transition. Future operations and services define the system outputs, the staffing type and mix of an office, and the field structure needed to efficiently provide these services. These, in turn, set requirements for training and education, facility preparation, and guide a number of other dimensions of the modernization and associated restructuring. A realistic view of technological capabilities, resource availability and schedules, and the NWS environment will help shape the scope and pace of service changes.

The breadth of future operations and services is bounded by the agency mission and scientific and technological capability. Transition planning will recognize and incorporate these factors, and retain sufficient flexibility to respond to these dynamics. The NWS will plan and maintain a steady and predictable pace for implementation to allow sufficient time for orderly change and adjustment, both internally and externally, and to accommodate and capitalize upon the new knowledge and understanding acquired throughout the transition period.

DEMONSTRATION AND CERTIFICATION

The modernization and associated restructuring of NWS features improved services through the effective and efficient use of the new technology. Aspects of this objective imply significant change both internally and externally. Active participation by NWS employees and external users is imperative for a successful transition. Support will be sought by informing them in advance of what changes are planned and why these changes are needed. Clear demonstrations of the service improvements that will result from these changes are a critical element in obtaining NWS employee and external user acceptance.

Demonstrations of new capabilities and services will take place through a wide range of activities. The Modernization and Associated Restructuring Demonstration (MARD) will be the centerpiece for demonstrating the fully modernized and restructured NWS of the 1990s. As currently planned, MARD will take place in a multi-state area in the central United States which is extremely prone to severe weather. Once the

proper number and mix of staff is in place along with the new technology, and training has been completed, a number of WFOs supported by RFCs and National Centers will operate in the modernized and restructured mode as the first step towards national conversion to the new structure.

The primary objectives of MARD are to demonstrate more accurate and timely warning and forecast services and to provide an opportunity to evaluate service performance and responses of users within the context of the most cost-effective organizational structure. MARD will help refine new operational procedures and resolve implementation issues that can best be addressed through actual field experience. MARD will also provide an opportunity to examine additional organizational efficiencies that may be gained from application of the new science and operation of the new technology, such as a 2-tier field office structure with reduced staffing at some offices.

Based upon the MARD experience, full implementation of modernized and restructured operations will proceed on a national basis in compliance with the provisions of Public Law 100-685. During national conversion to the new structure, existing weather service offices would be closed, consolidated, automated or relocated only when such action can be certified to result in no degradation of services to the affected area.

IMPLEMENTATION SCHEDULE

Programs to acquire the new technology have been approved, and acquisition is underway. Developmental efforts to simulate the Weather Forecast Office of the 1990s have been undertaken since the late 1970s at NOAA's Environmental Research Laboratories as part of the Program for Regional Observing and Forecasting Services. Planning for application of the new science, transformation of the workforce, and the deployment of the new technology has been started. In a broad outline, the implementation schedule for modernization and associated restructuring of the NWS will consist of activities bracketed in time between now and MARD that must be accomplished in preparation for the demonstration, the Modernization and Associated Restructuring Demonstration itself, and implementation of full modernized and restructured operations after MARD. Field preparatory and risk reduction activities requiring long lead times to complete have already begun, and are scheduled to ensure their timely completion.

EXPERIMENTAL SYSTEMS

Additional work is underway on other technologies, though technically not now a part of the modernization program. As the research community continues development of experimental systems to improve observational techniques or improve operating efficiencies, demonstration networks may be deployed at specialized operational sites to establish and validate the utility of the new data or improved system. These centers of excellence provide unique opportunities for the research and operational communities to jointly assess and improve the operational utility of the new scientific innovations.

A demonstration project is underway that will deploy a new ground-based atmospheric sounding system, the wind profiler. This system will provide data on atmospheric winds with time and height resolutions not economically available with alternative techniques. Research is also continuing on thermo-dynamic profilers that may ultimately make important improvements in the acquisition of moisture and temperature information and lower the operating costs of today's upper air program.

PRODUCTIVITY AND EFFICIENCY ADVANTAGES

In designing the modernized and restructured NWS as a complete system, as opposed to the current system, which has evolved sporadically throughout the agency's history, improvements in services can be combined with productivity and efficiency gains by deliberate design of the new NWS.

Productivity and service improvements will be achieved by automating observation and communication duties, freeing trained professionals to concentrate on the highest operational priority -- analyzing and forecasting local atmospheric events. Because the data available from the precisely organized satellite, surface observing systems, and Doppler radar networks can be processed and manipulated by tomorrow's meteorologists, more accurate and timely warnings and forecasts can be provided by fewer field offices. Using more data with fewer offices and a core of professional personnel translates into higher productivity.

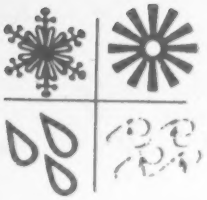
The productivity gains acquired with the professional workforce, new science, and advanced technologies, in turn, mean operational efficiency gains. That is, lower costs associated with delivering more accurate and timely warning and forecast services are accomplished while concurrently increasing the benefits from more timely, pertinent information. The efficiency gains, once achieved, are a direct product of the entire operational design of the modernized structure.

MEETING THE CHALLENGE OF THE 1990s

Understanding and predicting weather, climate and the state of the Nation's rivers has never been more important to the people of the United States and the world. Major advances in technologies, scientific understanding of the atmosphere, and in the prediction of the localized, most severe storms are within reach. While the resources to achieve the goals set forth in this Strategic Plan are significant, they pale compared to the savings of lives and property attainable through the modernization and associated restructuring of the National Weather Service. The challenge of the modernization and associated restructuring is to configure the NWS field offices, implement the new systems and networks, and professionalize the NWS workforce, without diminishing ongoing operations.

This document summarizes the opportunities and challenges that the Nation faces in modernizing and restructuring its capability to detect, understand, and predict our atmosphere. The discussion focused on the new scientific concepts that foretell significant advances in meteorology and hydrology. It considered the technology available to effect these advances and scientific concepts -- automated surface observations, Doppler radars, satellites, supercomputers, and advanced information processing technology.

The people, the new technology, and the new ideas at hand combine to offer unprecedented advances in hydrometeorological prediction and in understanding climate change.



National Weather Service
Employees Organization
AFFILIATED WITH MEBA AFL-CIO

RESPONSE TO THE STRATEGIC PLAN FOR THE MODERNIZATION AND ASSOCIATED RESTRUCTURING OF THE NATIONAL WEATHER SERVICE AND RECOMMENDATIONS

The Response to the Strategic Plan for the Modernization and Associated Restructuring of the National Weather Service and Recommendations is published by the National Weather Service Employees Organization and written by NWSEO President John D. Quadros with the invaluable assistance of the members of the National Council, members of NWSEO, Chwat/Weigend Associates, and General Counsel Richard J. Hirn. *The Response* was edited and designed by NWSEO Director of Membership Services Peter J. Nuhn and published in Washington, DC, May 1989. Please send comments to NWSEO, 400 N. Capitol St., Suite 326, Washington, DC 20001.

Copyright 1989 by National Weather Service Employees Organization.
Permission is granted to quote this report with attribution.

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	PRINCIPLES FOR THE MODERNIZATION AND ASSOCIATED RESTRUCTURING	1
III.	NEED TO IMPLEMENT NEW SCIENCE AND TECHNOLOGY	4
IV.	MAJOR TECHNOLOGIES FOR MODERNIZATION	5
V.	NEED TO RESTRUCTURE	9
VI.	WFO AREA OF RESPONSIBILITY AND INTEGRATED OPERATIONS WITHIN THE WFO	10
VII.	THE NEW STRUCTURE	14
VIII.	STAFFING	15
IX.	TRANSITION PLANNING	17
X.	DEMONSTRATION, CERTIFICATION, AND IMPLEMENTATION	18
XI.	EXPERIMENTAL SYSTEMS	20
XII.	PRODUCTIVITY AND EFFICIENCY ADVANTAGES	20
XIII.	BIBLIOGRAPHY	22

21-905 0 - 89 - 4

I. INTRODUCTION

In March 1989, the National Weather Service (NWS) submitted to Congress a "Strategic Plan for the Modernization and Associated Restructuring of the National Weather Service." The National Weather Service Employees Organization (NWSEO), as the representative of the affected employees, has prepared this response to that plan.

There is nothing basically wrong with the goal set by the NWS:

> "To modernize the NWS through the deployment of proven observational, information processing, and communications technologies, and to establish an associated cost-effective operational structure. The modernization and associated restructuring of NWS shall assure that the major advances which have been made in our ability to observe and understand the atmosphere are applied to the practical problems of providing weather and hydrologic services to the Nation."

What is basically wrong, and what NWSEO takes exception to, are many of the assumptions relied upon by the NWS in developing the Strategic Plan. The catchwords "cost effective" are a fact of life in the federal government as this nation heads into the 90s. The NWS Strategic Plan is <u>not</u> cost effective.

The Response to the agency's Strategic Plan contains specific recommendations that Congress and the administration will find are more cost effective, technologically sound alternatives to various aspects of the modernization and restructuring plans developed by the NWS. These forces that shape the NWS budget must be channeled to provide the American public with an adequate, modern weather service.

II. PRINCIPLES FOR THE MODERNIZATION AND ASSOCIATED RESTRUCTURING

The Strategic Plan describes the NWS mission as providing

> "weather and flood warnings, public forecasts, and advisories for all of the United States, its territories, adjacent waters and ocean areas, primarily for the protection of life and property. NWS data and products are provided to private meteorologists for the provision of all specialized services."

This statement is a major departure from the mission of the agency as stated in the NWS Organic Act of 1890:

> "The Secretary of Commerce shall have charge of the forecasting of weather, the issue of storm warnings, the display of weather and flood signals for the benefit of agriculture, commerce and navigation, the maintenance and operation of seacoast telegraph lines and the collection and transmission of marine intelligence for the benefit of commerce and navigation, the reporting of temperature and rainfall conditions for the cotton interests, the display of frost and cold-wave signals, the distribution of meteorological information in the interests of agriculture and commerce, and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties." (emphasis added)

By redefining its mission, the NWS is divorcing itself from service to the economic and business concerns of the United States. It continues the long march toward a simplified weather service, one that provides only basic public forecasts and warnings. It continues the long march toward a weather service that is uninvolved with commerce and raises the obvious question, "Why is the NWS in the Department of Commerce if it no longer intends to aid and promote the nation's commerce?". It continues the long march toward "privatization" of the NWS by stripping forecast services involving aviation, marine, satellite interpretation, fire weather, air pollution, agriculture, and fruit-frost functions from the mission and leaving them for private meteorologists. Only those who can afford such services will prosper. The economic loss is incalculable.

The Strategic Plan identifies what it terms as "essential principles." The first among these is that "the modernization and associated restructuring process will not result in degradation of services to the general public." Unfortunately, the degradation of services has already begun. To pay for the development of the new technology to date and to keep within restrictive budgets, massive decreases in programs and depletion of the work force has taken place over the past 8 years. For example, the NWS Western Region decreased from 900 positions in 1981 to 703 in 1985 and dropped to 581 by 1989 (with 69 of these currently vacant).

The second principle is that "NWS employees will be involved" in the development and implementation of the Strategic Plan "because their participation is crucial to a successful transition and improved operations." This has simply not been the case. The text goes on to discuss training,

which may be what the NWS feels is sufficient employee involvement; but training is not cheap, and the new technology is not easy to operate. If the manner in which the agency trained its employees to use AFOS--the NWS' current product composition, dissemination, and communications system--is any indication of the agency's commitment to training, we are neither optimistic nor encouraged. Did the NWS learn from the mistakes it made during AFOS training?

The Strategic Plan's third principle, "that U.S. international meteorological and hydrologic obligations will be met during and after the modernization and associated restructuring," cannot be met because the quality of observational data will deteriorate as observations are automated or turned over to less qualified non-NWS observers.

The fourth principle, "that NWS employees will continue to provide the quality weather services required by the country in the most economical manner," must take into account the fact that the NWS operational budgets can not be reduced indefinitely without a corresponding human loss or economic loss to the nation's commerce and business interests.

The Local Warning and Forecast program of the National Weather Service has an annual budget of about $240 million, or just $1 for each U.S. citizen. Does any other service to the American public come so cheaply? In comparison, the U.S. Government proposes to spend $190 million in climatological research.

RECOMMENDATIONS:

A. The Congress and the Executive Branch must take the necessary steps and provide the necessary funding to restore the NWS to its former preeminent position among world weather services.

B. The NWS must keep its Mission as stated in the Organic Act, unless changed by Congress.

C. No further work force reductions, station closures (full or part time), station relocation or consolidation, or automation of function should take place without congressional consent.

D. NWSEO, in its capacity as work force representative, should be brought in as a full participating partner in the changes that the NWS goes through in its modernization.

III. NEED TO IMPLEMENT NEW SCIENCE AND TECHNOLOGY

The Strategic Plan correctly observes that the "vintage technologies that compose part of today's weather service infrastructure need to be replaced." Many of these technologies were so long in development and production that when deployment took place, obsolescence was inherent in the system. The NWS' current computer and communications system, AFOS, is a prime example. Computer technology has been and will continue to be fast paced. The replacement system for AFOS, called the Advanced Weather Interactive Processing System (AWIPS), must be developed with the evolving nature of computer technology in mind. The system must be designed so that advances in one part of the system can be incorporated without replacing or modifying the entire system.

Advances in mesoscale meteorology, a scale that indeed is "well below the operational resolution of routine observations and analysis today," dictate concentration of forecasts and warnings at this level. To take full advantage of these advances, the technology must improve to detect meteorological parameters at this scale. To date, this is not the case. The technology has not been proven. Automated Surface Observing System (ASOS), as it is currently being developed, is not a replacement for a human observer and at best will only provide a partial supplemental surface observation. Profiler technology is still under development. Next Generation Weather Radar (NEXRAD) technology seems to improve the ability to detect severe weather and its precursors, but at a smaller radius than advertised.

When the new technology does reach the proven state, the employees using it must be adequately trained to realize its potential. Again, this was not the case when AFOS was installed.

RECOMMENDATIONS:

A. Research and development of the new technologies should continue, but implementation should only be undertaken when the new technology is proven.

B. System design, particularly of AWIPS, should be modular so that advances in part of the system will not render the entire system obsolete.

C. Once proven, the technology should be produced and deployed as rapidly as possible to take advantage of the improved capability as soon as practicable.

D. Personnel training should be properly funded so that the full benefits of the advances in the science and technology can be realized.

IV. MAJOR TECHNOLOGIES FOR MODERNIZATION

The cornerstone of any forecast system is observations. Inadequate areal coverage, unreliable equipment, or missing data all lead to a deteriorated forecast product. New equipment must be at least as reliable as present equipment.

The first major technology discussed in the Strategic Plan is ASOS. ASOS has been more thoroughly tested than NEXRAD, but the results of the tests have been discouraging and demonstrate that fully automated weather observations are not now technologically feasible.

Each ASOS installation will comprise several different sensing devices. The Precipitation Sensors Test Report, pp. ii, 4-9 (February 1988), prepared for the Joint Automated Weather Observing Program Council, reported that the freezing precipitation sensors failed to meet requirements of the ASOS program during field tests.

ASOS is incapable of detecting cloud cover above 10,000 feet. According to the Preliminary Evaluation, Automated Surface Observing System, Kansas Pilot Project, p. 21 (September 1986), "(w)ithout cloud information above 10,000 feet, the ASOS observations alone cannot establish total sky cover. Satellite imagery may ultimately provide only part of the solution."

The cloud height indicator "occasionally does not detect stationary or widely scattered cumulus clouds," Preliminary Evaluation, p. 10. See also, ASOS Project Report, Vol. IV, No. 3, pp. 7-8 (September 1988). Furthermore, it takes 30 minutes for the cloud height indicator to detect cloud cover, while a human observer can do so instantly. Id.

The cloud height indicator reports false readings during mild precipitation and fails completely during heavy precipitation. ASOS Project Report, Vol. IV, No. 4, p. 5 (December 1, 1988).

Testing conducted at the ASOS Kansas Pilot Project (KaPP) also revealed additional, unacceptable failures in automated weather observations:

> "Present weather detection was very limited in KaPP. The LWI (laser weather indicator) did not work properly and consequently did not adequately discriminate among rain, snow, drizzle and hail at Goodland and Concordia (the only two stations that have present weather sensors). Also, the detection of sleet and mixed precipitation was beyond the capability of the LWI. Elements such as lightning and freezing rain were detected with partial success....The KaPP did not demonstrate adequate present weather detection capability...." Preliminary Evaluation, p. 21.

> "In a system such as ASOS, it is crucial that all components (including the basic electronics and sensors) perform in a highly consistent and reliable manner...(D)egraded performance of one component impacts overall system performance." Preliminary Evaluation, p. 9.

The second major technology discussed in the Strategic Plan is NEXRAD. NWSEO's main concerns about this system are that it be evaluated properly and certified by independent observers as a proven system before full-scale procurement and that Congress and the American public not be oversold on the technology.

Until late March 1989, NEXRAD had not been tested outside the contractor's facilities. This first test using NEXRAD in a real life forecasting situation is being run in Norman, OK. The testing is being conducted under a veil of secrecy. All personnel working at or visiting the test site are required by the U.S. Air Force to sign a statement of non-disclosure. This may be intended to prevent leaks of unrepresentative results, but it leads to the appearance of a cover-up of the testing process.

The NWS has promised more than Doppler radar, such as NEXRAD, can deliver. Although it is possible for Doppler radar to detect tornadoes and mesocyclones through its ability to display radial velocity data, the effective range of this enhanced detection ability is quite limited because of its beam width. For example, at a distance of 60 km (36 miles), NEXRAD will only be able to resolve weather phenomenon that is at least .25 km by .25 km. Next Generation Weather Radar Product Description Document (December 1986). Fewer than 10% of the tornadoes in the eastern third of the United States are large-scale F5 tornadoes, and most will escape detection on NEXRAD unless they occur within 30 miles or so

of the Weather Forecast Office (WFO). The NWS plans to space the Weather Forecast Offices hundreds of miles apart. In fact, no WFO is planned at all for the interior of the states of Ohio and Kentucky. The population centers of Columbus, OH; Richmond, VA; Chattanooga, TN; Charlotte and Winston-Salem, NC; Greenville, SC; Columbus and Savannah, GA; and Montgomery, AL, are each at least 100 miles from a planned NEXRAD location. Recent devastating tornadoes in Wichita Falls, Waco, Paris, and Saragossa, TX, would not have been caught by the planned NEXRAD network.

Other technical shortcomings of Doppler radar are reported in the NWS publication NOAA Training Paper NWS TC-1, "Doppler Weather Radar Principles," p. 19 (January 1983), including range and velocity folding (which causes erroneous replication of radar echoes), substantial delays in updates in data displays compared with conventional radar, problems in operator/user interpretation of the radar displays, and displays contaminated by insignificant or nonweather information. This publication also noted that "the small size of some types of tornadic vortices may preclude detection."

NEXRAD was plagued by a high mechanical failure rate during testing by the Air Force in 1986 and 1987 at UNISYS's facilities in Bloomfield, CT, and Trevose, PA. During the 1986 tests, NEXRAD failed 138 times due to unknown causes. During the 1987 tests, NEXRAD's transmitter failed 5 times in 40 days, as opposed to the manufacturer's predicted failure rate of once in 170 days. The results of these tests, obtained by NWSEO through the Freedom of Information Act, also confirm NEXRAD's susceptibility to ground clutter contamination and velocity and range folding.

The Strategic Plan next discusses satellite upgrades. The field eagerly anticipates the new generation of Geostationary Operational Environmental Satellite (GOES) (I through M) and the new generation of NOAA satellites (K through M). The two geostationary, two polar orbiter satellite configuration is a necessity, not a luxury. Attacks on this configuration, usually brought about by budget considerations, are ludicrous. Through a combination of bad luck and bad planning this country now has only one operational geostationary satellite. There is no guarantee that this satellite will last until the next geostationary satellite launch, slated for mid-1990. Even if the current GOES survives and the new GOES satellite is successfully launched, the chances are high of reverting to a one satellite mode before GOES J is launched in 1992.

We agree with the NWS that "the future requirement for guidance products for mesoscale warnings and forecasts is greatly increased over the present" and that this supports the acquisition of a Class VII computer.

C. The NEXRAD system should not be oversold. Realistic expectations of the Doppler technology should be documented. The public should be frankly informed that the effective range of the Doppler feature of NEXRAD is limited and that many small and medium sized cities will not benefit from the acquisition by the NWS of Doppler technology because of their distance from planned radar sites.

D. The two geostationary, two polar orbiter configuration of U.S. satellites should be restored with adequate back-ups available to reasonably account for rocket or equipment failure.

E. Acquisition of a Class VII computer is a necessity. The United States should commit itself to staying on the edge of the technology, rather than trailing behind the rest of the world's technological leaders.

F. The AWIPS technology must evolve in synchronization with the other new technologies and allow for periodic upgrades (not long-term replacement) as the technology advances. The NWS must not repeat the mistakes of AFOS implementation.

G. The concept of NOAAPORT should be rethought. It is not right to contract out control of weather data and products. Costs should be limited to legitimate dissemination expense.

H. Training of personnel in the new technologies must be a top priority and adequately funded. Only proper training will allow expensive new technology to serve the American public to its maximum capability.

V. NEED TO RESTRUCTURE

A restructured weather service to take full advantage of the new science and technology is basically a good idea, but should be undertaken for that reason alone. The current structure has undergone periodic changes, driven purely by budget considerations. The current structure has become inefficient and an outright danger to the American public due to service cutbacks, understaffed offices, aging technology and a demoralized work force.

Recent moves by OMB changed the request for Class VII computers to computers with Class VII capabilities. This is a subtle but significant difference. We favor the acquisition of the most up-to-date technology and not mere modification of the NWS' existing computers. One of the reasons this country's weather service has fallen behind the rest of the world is its inability to keep current in state-of-the-art computer systems. Europeans have demonstrated an ability with new generation computers to outforecast the United States in both smaller scale and longer range.

AWIPS will replace AFOS as the system that integrates data, analysis and guidance products to aid in the formulation of warnings and forecasts. Dr. Joanne Simpson, president of the American Meteorological Society, stated in testimony before Congress, "There are five tightly meshed components which must be moved forward in a synchronized orderly fashion so that the whole system is completely in place as soon as possible." And, she says, "(i)t is essential that the AWIPS be kept in phase with the other components of the upgrade" (her emphasis).

The AWIPS section of the Plan includes discussion of NOAAPORT. NOAAPORT takes the current dissemination system one step closer to outright sale of weather data and products. A contract vendor would charge for the receipt of products and control their dissemination by use of such methods as encrypting devices. Access would be limited to those with the means to pay for desired services. The NWS has already signed a contract with Weather Services Incorporated (WSI). WSI is marketing radar composites to their clients. With such contract vendors as the ones set up through NOAAPORT and WSI, small users would be at a disadvantage, and newcomers into the field of private meteorology would have a bigger obstacle to overcome.

RECOMMENDATIONS:

A. In light of the many problems with ASOS, the Strategic Plan should have detailed plans for its use. What human supplementation is necessary? Who will do it? Who will pay for it? These questions need to be answered before the system is implemented.

B. In light of the many problems with NEXRAD, further testing in real life forecasting situations must be completed and independently assessed before procurement of the system proceeds. The veil of secrecy surrounding the testing should be lifted.

The Plan states that "the percentage increase in meteorologists in the NWS work force will improve warnings and forecasts by taking advantage of the capabilities of the new technologies." It is NWSEO's contention that meteorological technicians, particularly those working with existing radar, and those with meteorology and related degrees are also fully capable of taking advantage of the new technologies. The U.S. Air Force, which will also utilize NEXRAD, has determined that their system will be manned by NCOs. Many NWS met techs are former NCOs with radar and forecast experience. The Air Force values its NCOs. Why doesn't the NWS value its met techs? The work force should reflect a more even mix of mets and met techs.

The plan goes on to say that "an increased effective range of the radar systems and the ability to assemble all data at a reduced number of offices increases productivity and efficiency." Nowhere has there been any demonstrated increase in the effective range of the conventional radar, and as discussed, the effective range of the Doppler function is quite limited and far less than the effective range of conventional radar technology. Nowhere has it been proven that a reduction in the number of offices will lead to increased productivity. By this same convoluted argument, one could assume that a reduction of offices to zero would be the most productive form of restructuring.

RECOMMENDATIONS:

A. Restructuring should be driven by the implementation of the new technologies.

B. The work force balance between mets and met techs should be more even, so as not to discard the radar interpretation talents of a significant portion of the current met tech work force.

VI. WFO AREA OF RESPONSIBILITY AND INTEGRATED OPERATIONS WITHIN THE WFO

The Strategic Plan provides a map depicting the NEXRAD coverage over the continental United States. This map shows circles drawn at a radius of 125 miles around each of the radar sites. East of the Mississippi River there are no gaps depicted in the coverage. To the west, however, there are gaps in the Rocky Mountains and to the east of the Cascades and Sierra Nevada. The map equates to maximum radar coverage at the

NEXRAD SITES WITH OPTIMUM COVERAGE FOR DETECTION OF TORNADO VORTEX SIGNATURES (70 km)

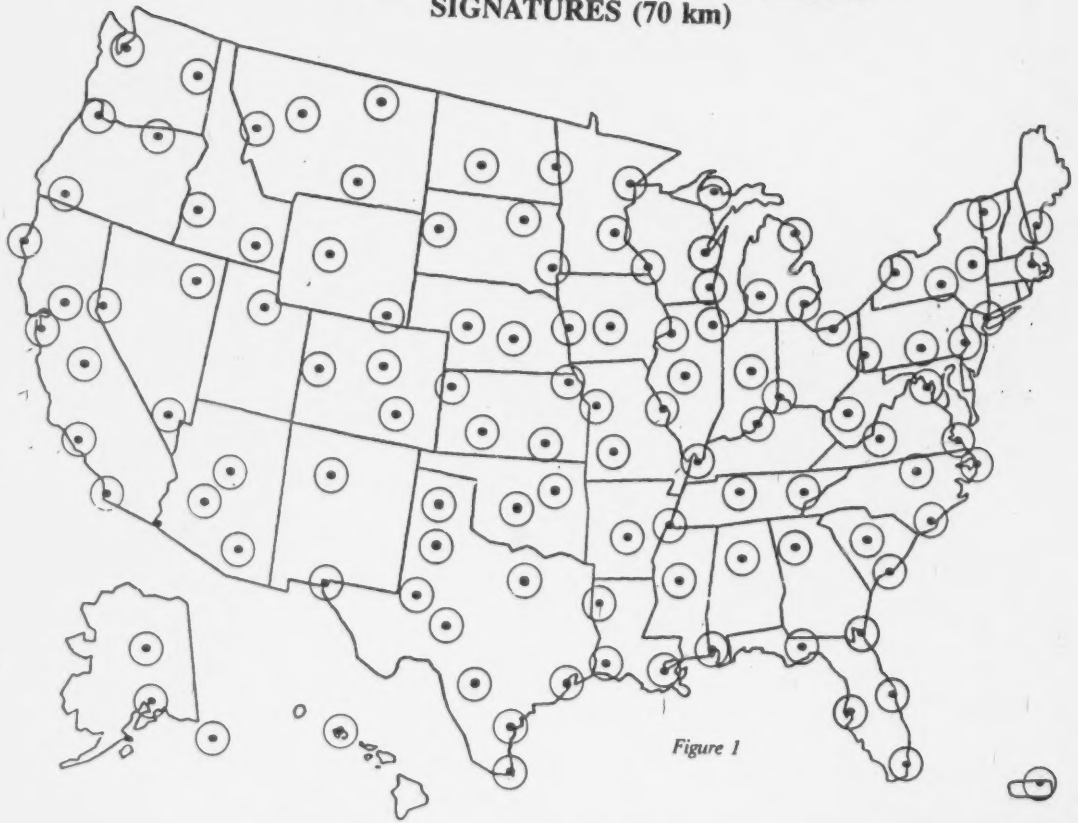


Figure 1

10,000 foot level. This level is of course above much of the weather that affects the United States and limits the coverage of the conventional radar mode to about this 125 mile distance. Also affecting the coverage would be the height of the radar itself. For instance, the radar serving the 5 million people in the San Francisco-Oakland-San Jose metropolitan area will be situated at 3,000 feet, above much of the weather that affects that area.

Figure 1 depicts optimum coverage for detection of tornado vortex signatures. Beyond this distance, tornadoes can only be deduced from detection of mesocyclones, weather systems which can spawn tornadoes. However, limitations imposed by the beam width also affect detection of mesocyclones.

The NWS has operated prototype offices utilizing some of the new technology for the past few years. At the Oklahoma City Weather Service Forecast Office (WSFO), forecasters have a drop on the Doppler radar operated at the National Severe Storms Laboratory (NSSL) in Norman. According to the Strategic Plan Verification/Evaluation Update, March 1989, severe thunderstorm verification was better than the rest of the forecast offices in the Southern Region by a 2:1 margin. Two facts temper those results. First, the NSSL radar has a .50 degree beam width as compared to NEXRAD's .95 degree. The narrower NSSL beam width will produce better resolution. Second, the Update concludes that "tornado results by themselves were not impressive."

Statistics show that 2/3 of the warnings issued by the WSFO in Oklahoma City were for areas less than 50 miles from the office and only one warning in 7 was for an area greater than 100 miles from the office, Strategic Plan Verification/Evaluation Update. This shows the limited range of the Doppler feature, and is a strong argument for more closely spaced NEXRAD sites.

In Denver, The Program for Regional Observing and Forecasting Services (PROFS) has made both new and conventional data sets available in real-time to the forecasters at the Forecast Office. The new data sets are produced from a workstation that is a forerunner of AWIPS. In addition, a Doppler radar is available. Early results, although very limited in scope, are encouraging with an increase in warning lead time, and a decrease in the average area warned during each severe weather episode, Strategic Plan Verification/Evaluation Update.

If the radar coverage is inadequate from the standpoint of normal radar detection capabilities, and certainly inadequate for Doppler capabilities, what drove the determination that approximately 115 sites would be needed? A letter from the head of the NWS to the head of NOAA states

that there are "solid technical justifications for 15-20 additional Weather Forecast Offices." Was it a case of first determining what amount of money the Office of Management and Budget (OMB) would allocate for NEXRAD (the most expensive component of modernization) and then determining the number of NEXRADs? In other words, it is obvious that budgetary considerations were the deciding factor in the size of the NEXRAD network. Were these same budgetary considerations the reason it will take so long to implement the system, even after it is tested and independently certified?

Every NEXRAD will have an associated WFO. The mentality behind the design of the WFO can best be described as the "cookie cutter syndrome." Every WFO will be nearly identical. Each will have its own NEXRAD. Each will have very similar staffing. Each will have the same forecast programs. There are strong arguments against this approach: (1) precipitation patterns vary from one part of the country to the next; (2) temperature patterns also vary; (3) the user community is uniquely different at each location; (4) population of each WFO's area can vary from a few thousand to 10 million; (5) topography is widely variable across the country; and (6) the size of the area served by each WFO can vary considerably.

To accommodate this cookie cutter approach to future NWS operations, specialized programs are being systematically stripped from the field and placed into remote national centers, which have become clearing houses for any forecast program that won't fit. Forecasts for agricultural interests including the fruit frost program are being abandoned. Even farmers who can afford to hire private meteorologists don't want this program to end. Those who can't afford the service will suffer the consequences. Aviation area forecasts, high seas and offshore forecasts, and satellite interpretation are being consolidated in national centers far removed from the area of responsibility. The "bull's-eye effect" is real. This means better services in close proximity of the offices, but a significant degradation of services in those communities that are not near a WFO. A study prepared by the NWS Services Evaluation Branch shows that both temperature and precipitation forecasts are better when prepared locally as opposed to remotely by a national center, Strategic Plan Verification/Evaluation Update. Other nations have learned the folly of this thinking. The United States must not repeat this mistake. No one wants to be responsible for the consequences.

RECOMMENDATIONS:

A. If proven, determine how many NEXRADs are really needed. Consider deployment of new conventional radars in the mountainous West where the Doppler capability is least needed and will provide the least benefit.

B. Rethink the cookie cutter approach. Accept the fact that there are many variables in the system. Tailor staffing and programs to the needs of the user community and physical characteristics of each WFO area.

C. Have the NWS disclose which 15-20 additional NEXRAD/WFO sites are justified and add them to the Plan.

D. Reestablish a Pacific coast national center for the Pacific Ocean high seas and offshore marine forecasts and GOES West satellite interpretation.

VII. THE NEW STRUCTURE

The most striking feature of the new structure proposed for the NWS under modernization is how dramatically the field changes in relation to the national centers. Despite the dramatic reduction in number of offices (from a high of about 300 a few years back to about 250 currently and 115 in the mid 90s), there is little or no change planned for the national centers, except for technology.

The Plan mentions that operations at the 13 River Forecast Centers (RFCs) will be expanded to 16 hours per day to take advantage of expanded data input. Again, budget considerations come to the fore. Why, if data is now going to be routinely available around the clock, are the centers only going to operate 16 hours per day? Weather knows no clock. The likelihood of hydrologic events is just as great on the midnight shift as at any other time. Support to the field is needed on a continual basis.

No change in staffing or mission is slated for the National Meteorological Center, The Climate Analysis Center, the National Hurricane Center, the National Severe Storms Forecast Center or the National Data Buoy Center. If upwards of 150-180 cities are losing their local weather office, who will continue the valuable work of setting up and maintaining spotter networks, local climate networks, and community preparedness. Or will

these programs fall victim to the mistaken assumption that new technology will render them obsolete?

No mention is made in the Plan of regional headquarters under the modernized NWS. Will as many still be needed? No mention is made of regional or area forecast coordination centers. Currently, there are 52 autonomous Forecast Offices. In the new system this number will more than double. The chances of conflicting forecasts will be greatly increased, much to the detriment of the products provided to the public.

An earlier version of the Plan included 50-80 Community Service Offices (CSOs) and Local Weather Offices (LWOs). OMB stripped those offices from that earlier Plan. Those offices, staffed on a part-time basis, would have continued many of the valuable weather support functions to local communities that will be lost under the current Plan.

RECOMMENDATIONS:

A. Study the national centers for changes necessitated by such a large change in the field structure.

B. Operate the RFCs on a full time basis. Either their support is vital all of the time or not at all.

C. Assure that there is continuity of community interaction programs. This burden must be shared at the national centers and not foisted entirely upon a reduced field structure.

D. Reduce the number of regional offices. Fewer employees in the field need less support at this level.

E. Reintroduce the concept of regional or area forecast coordination centers.

F. Restore to the plan the 50-80 CSOs and LWOs originally intended.

VIII. STAFFING

The Strategic Plan is devoid of details as to number and grades of staff at the WFO. The text lists "a core staff of professional scientists," "meteo-

rological technicians," "electronic technicians," a "Meteorologist-In-Charge," and a nebulous "support staff" that will provide "critical program and maintenance support to ensure efficient operations and for the practice of advanced applied science." Additionally, some WFOs will have Service Hydrologists.

NWSEO has been informed that expected staffing at a WFO will allow for two meteorologists and one meteorological technician per shift, except for reduced coverage of one meteorologist on the midnight shift. This would mean 8 mets and 5 met techs per station in the operating unit for a nationwide total of 920 mets and 575 met techs.

The projected number of electronics technicians is unknown (a document prepared in conjunction with a technical advisory committee lists one el tech per WFO). It is known that preparations for NEXRAD maintenance training are under way at the National Weather Service Technical Training Center in Kansas City. It is also known that NWS el techs will provide maintenance not only for NWS ASOS units but also for those operated by the Federal Aviation Administration (FAA).

Any way you look at it, all of this represents a decrease in the number of field employees in the NWS. Personnel costs make up the bulk of any agency's budget. It is apparent that DOC/NOAA has struck a deal with the devil. OMB has extracted the soul of the NWS in exchange for granting budget monies for the new technology.

The insidious practice of "fair weather staffing" will persist in the NWS into the next century. It is just plain bad management to provide for coverage under the best of conditions, while relying on dedicated employees, overtime, and support staff to cover in the worst of times. This practice has brought morale in the NWS to its lowest level in history. The seed that has been planted in such a climate can not help but bear bad fruit.

RECOMMENDATIONS:

A. Adjust staffing to a level between minimum and maximum workload requirements. "Fair weather staffing" will cost the American public more in the long run.

B. As in Section VI, tailor staffing and programs to the needs of the user community and physical characteristics of each WFO area.

IX. TRANSITION PLANNING

To get from the NWS of today to the modernized NWS of tomorrow, the Strategic Plan discusses the need for a transition plan. This planning has proceeded virtually unnoticed by field personnel with only a mixture of rumor and leaked fact reaching the average employee. Rather than pass on information about the future, a veil of secrecy has surrounded the planning. The Transition Program Office came into being only recently when, evidently, there was a belated realization that the transition must be a coordinated event. Even today the office operates with a minimal staff.

Technology will be phased in over a long period of time. Many station relocations and closures will take place, necessitating shifting of personnel. New systems will have to work side by side with the old until all of the new technology is in place. The new WFO structure will have to straddle both the old way of doing things and the new.

A four-tier structure is put forth to accomplish the transition. The top tier is the Strategic Plan itself. The second tier is the National Implementation Plan, which presumably will flesh out the Strategic Plan. The third and fourth tiers will be Regional and Site Transition Plans, which will bring the National Implementation Plan down to the station level. There is nothing wrong with this structure providing (1) employee input through NWSEO is solicited and worked into the plans and (2) the Transition Program Office coordinates the Regional and Site Plans and has the latitude to properly manage the transition.

The last paragraph in this section of the Strategic Plan states, "(T)he breadth of future operations and services is bounded by the agency mission and scientific and technological capability." If only this were true. The main governing factor on the breadth of future operations and services will continue to be budget considerations. Nowhere else in government will there be such a direct relationship between money spent and service rendered.

RECOMMENDATIONS:

A. The Transition Program Office should solicit and assimilate suggestions from the employees of the NWS on modernization by placing an NWSEO representative on its staff.

B. A more detailed plan for the future NWS operation should be provided to NWS employees through NWSEO in advance of the required submission to Congress.

X. DEMONSTRATION, CERTIFICATION, AND IMPLEMENTATION

The NWS plans to test the new technology and the new structure in the central United States in a program called the Modernization and Associated Restructuring Demonstration (MARD). Unfortunately, reductions in the FY90 budget will delay the beginning of the demonstration.

In the meantime, testing of the NEXRAD system will continue in Oklahoma. This is a critical phase in the development of this technology. NEXRAD must operate in a reliable manner in a real time forecast environment away from the UNISYS facility. The testing must include evaluation of the Doppler feature's real operating range, evaluation of the system's detection capabilities in a conventional mode, evaluation of an operational forecaster's ability to utilize the system to its maximum potential, and evaluation of the system's ability to operate with a minimum of down time.

When properly certified, NEXRAD will be deployed not only as a part of the MARD experiment but at operational sites near Oklahoma City, OK; Melbourne, FL; and Washington, DC. The latter two sites will allow testing in a coastal and large urban area environment, respectively. This is important because each NEXRAD site will pose unique problems. Another major test area should be the mountainous West. Will the NEXRAD capabilities be fully realized in this terrain? Will siting at high elevations negate some of the advantages of the system? Can new conventional radar do the job in the West at a reduced cost?

ASOS has not demonstrated the ability to produce complete surface observations without human supplementation. Current regulations require that a complete surface observation be available to the forecaster before an aviation terminal forecast can be issued. If a critical element of the observation is missing, no terminal forecast is available, which can seriously affect commercial and private aviation operations. Whoever is chosen to supplement the ASOS observation, it must be their primary duty. Currently, with part-time closures of weather service offices, observation responsibility has fallen on air traffic controllers, flight service specialists, and airline personnel. A continuous weather watch is not their primary duty, and the resultant deterioration in the observations is apparent to all. The critical functions of controlling aircraft operations and briefing pilots

are their primary concerns. Supplementation of observations must be accomplished by NWS employees or contract observers.

Recently, a decision was made that NWS electronics technicians would maintain the entire ASOS network, which includes not only NWS sensors but also those of the FAA. At locations where observations support a terminal forecast, response time must be quick. With the proposed staffing of just one electronics technician per WFO, this may prove difficult.

AWIPS development lags in relation to the other components of the modernization. Procurement, demonstration, and certification of this system must proceed in a timely, coordinated manner. Much wasted effort will result if the new technology must be integrated first with the antiquated, overburdened AFOS system and then shifted to AWIPS. Moving AFOS hardware to a new office location only to have it scrapped in a relatively short time after the move is not cost effective.

When the proven technology is ready for implementation, the process must move more quickly than present plans indicate. Slow implementation will increase the period of time in which the NWS as a whole is disrupted by the modernization process. The speed of implementation should not be determined by budget restrictions.

RECOMMENDATIONS:

A. Budget restrictions must not delay MARD, a vital step in the certification of the modernization.

B. Upon completion of NEXRAD testing, make known the true capabilities of the system so that a proper evaluation of WFO distribution can be made.

C. Before implementing the full system nationwide, use the early sites to test the modernization concept not just in the Midwest but also at coastal sites, in large urban centers, and in mountainous terrain.

D. Supplement the ASOS system with human observers, at least at locations for which aviation terminal forecasts are prepared, with individuals whose primary duty is weather observing.

E. Augment the electronics technician staffing to take into account recently added responsibility. If equipment of other agencies is being maintained, obtain ET funding from that agency.

F. Develop AWIPS in conjunction with the other technologies.

G. Implement the proven technology as rapidly as is practicable.

XI. EXPERIMENTAL SYSTEMS

Brief mention is made in the Strategic Plan about wind and thermodynamic profilers. The objective of these systems is to provide moisture readings and data on temperature and atmospheric winds at a higher resolution and lower cost than present systems. Again, technology of this type will provide an expanded data base, which, in turn, will lead to a better forecast. Additionally, the need for a Class VII computer and new forecast models is reinforced.

RECOMMENDATION:

A. Continue development of profiler technology with efforts made to integrate this technology into the modernized weather service when proven.

XII. PRODUCTIVITY AND EFFICIENCY ADVANTAGES

The Strategic Plan draws a number of conclusions from the NWS plan to modernize and restructure the complete system. First, it asserts that "(p)roductivity and service improvements will be achieved by automating observation and communication duties." The time saved by automation of these often tedious duties will certainly lead to improved productivity and service. However, as discussed earlier, the automation of observations must not result in a degraded observation, nor must the automation of communications result in another overloaded, labor-intensive system like AFOS. It is vital that the modernization result in a better observation network with a user friendly, capable communications system. Only then can the full promise of productivity and service improvements be realized.

The second conclusion drawn is that "(u)sing more data with fewer offices and a core of professional personnel translates into higher produc-

tivity." This conclusion is certainly fuzzier than the first one. It can probably be shown that more data (assuming that they are of consistently good quality) will result in a better product.

What is not obvious, though, is that fewer offices (with fewer personnel) will be more productive. The current system features 52 forecast offices with 197 weather service offices. The Strategic Plan will reduce the total number to just 115. This will approximately double the area of responsibility that any one office will have.

Nor is it obvious that the Plan's heavy emphasis on what it terms as "professional staffing" (thus implying that met techs are non-professional) will result in more productivity. The NWS has alluded to studies that purportedly show that meteorologists verify severe weather warnings better than meteorological technicians. These studies have never been made public for criticism, verification, or interpretation, if in fact they exist. Attrition alone will not reduce the met tech staff in the NWS to the 575 operational positions in the WFOs. It would be wrong for the NWS to turn its back on the met tech work force, squandering a wealth of meteorological knowledge and experience.

RECOMMENDATIONS:

A. The number of stations needed to adequately cover the United States (and its territories) must be recalculated. The budget should fit the real need, not the reverse.

B. The discarding of met tech talent should not be allowed.

XIII. BIBLIOGRAPHY

1. ASOS Project Report, National Weather Service, Vol. IV, No. 3, September 1988.

2. ASOS Project Report, National Weather Service, Vol. IV, No. 4, December 1988.

3. Next Generation Weather Radar Product Description Document, The NEXRAD Joint System Program Office, December 1986.

4. NOAA Training Paper NWS TC-1, "Doppler Weather Radar Principles," National Weather Service, January 1983.

5. Precipitation Sensors Test Report, Joint Automated Weather Observing Program Council, February 1988.

6. Preliminary Evaluation, Automated Surface Observing System, Kansas Pilot Project, Automation of Surface Observations Program, National Weather Service, September 1986.

7. Strategic Plan Verification/Evaluation Update, Services Evaluation Branch, National Weather Service, March 1989

Testimony to be Presented

by

Carlton W. Ulbrich
Professor of Physics
Department of Physics and Astronomy
Clemson University, Clemson, SC

at the Hearing on

TORNADO WARNINGS AND WEATHER SERVICE MODERNIZATION

conducted by

U.S. House of Representatives
Committee on Science, Space and Technology
on
Tuesday, August 8, 1989
at
Spartanburg Technical College, Spartanburg, SC

I am a Professor of Physics at Clemson University and have been involved in atmospheric physics teaching and research for more than twenty years. My research has employed radar in a variety of experimental research projects. Among them are experiments designed to determine the effects of urbanization on the weather and to test our ability to suppress hail from large thunderstorms by seeding them with silver iodide. In addition, my work has involved development of methods by which radar can be used to measure rainfall amounts and toward determination of the effects of lightning on the distribution of precipitation particles in thunderstorms. In the conduct of this research over the past twenty years I have seen enormous advances take place in the ability of radar to accurately observe meteorological phenomena. I am confident that this capability will continue to improve in the future.

Radar meteorology is a relatively young field. The instrument was not used to intentionally observe weather until the early 1950's. The best that atmospheric scientists could do with radar during those early years was to detect the presence of precipitation. Today we have high confidence in radar as a technique to measure the amount of precipitation falling from clouds, to measure the sizes and shapes of precipitation particles, to determine the circulation patterns in clouds, to detect wind shear associated with downbursts from severe thunderstorms, to measure the winds in the clear air at high altitudes above the surface of the earth, to detect the presence of hail and intense cyclonic circulations (such as tornadoes) and much more.

Some of these capabilities are possessed by radars which are a part of the present National Weather Service network of weather radars. However, most of these advanced techniques are possible only with specialized, expensive radars located at a very few research facilities in the U.S. and overseas. The Weather Service radar network is aging and outdated and is scheduled to be replaced during the decade of the 90's with more modern and reliable equipment under project NEXRAD. These new radars will possess Doppler capability and should therefore be able to detect severe storm circulations. The savings in lives and property damage which should result from the early warnings made possible by these radars are obvious. However, because of limited federal funding much of what we scientists would prefer to see implemented on NEXRAD will have to postponed. We are hopeful that in the future sufficient resources will be found that the capabilities of these radars will be further enhanced through incorporation of modern research discoveries.

It should be noted that many of the modern advances in radar meteorology have taken place because of close cooperation between federal agencies and the university community. An excellent example is the relationship between the University of Oklahoma, the Weather Service and the National Severe Storm Lab in Norman, OK. These groups have worked together in the development of some of the most advanced meteorological radars in the world. They have formulated methods of detecting tornadoes and severe wind shear, clearly very important capabilities in Oklahoma. We at Clemson have recognized the increasing demand for young scientists trained in the use of radar to observe the atmosphere, and have therefore been attempting to build a group in radar meteorology over the last six years. We have also attempted to forge a relationship with the Weather Service by seeking funding in support of the acquisition of a weather radar which would be situated at the Greer Jetport. The presence of an advanced radar at the jetport would considerably enhance our ability to train students for careers in radar meteorology. It could also yield valuable data which could supplement the meager radar information from Athens, GA that is currently available to weather service forecasters at Greer. Certainly in a severe weather outbreak a forecaster would want to use every possible source of information to decide where and when severe storms will occur and whether to issue warnings concerning them. We are convinced that an advanced radar of the type I have described here would be of immeasurable value in that regard. Given the vagaries of the funding process, we cannot predict whether we will be successful in acquiring a radar. But if we do acquire such an instrument we believe that there will be clear benefits for all parties concerned including the general citizenry of upstate South Carolina.

1989-90 Cutting Edge Research Investment Fund Proposal

1. Period of funding requested: One year ___ or Two years _x_

2 Second Century Area: (Check the focus area you desire for your proposal's first level review)
___ Agriculture and Food _x_ Engineering and Basic Science ___ Marketing and Management
___ Quality of Life ___ Textiles

3. Title of Proposed Project An Advanced Meteorological Radar Facility for Research and Instruction in Atmospheric and Space Physics

4. Investigator(s): (List Principal Investigator first, followed by Co-PI's and Investigators)

Name	Department	Office	Phone
Carlton W. Ulbrich	Phys & Atron	212 Kinard	656-5322
Miguel F. Larsen	Phys & Astron	203 Kinard	656-5309
Lewis M. Duncan	Phys & Astron	106 Kinard	656-2219
Lee S. Miller	Phys & Astron	211 Kinard	656-5303

5. Amount requested $160,000

6. Anticipated matching fund $710,000

7. Source of matching funds NSF($80K/yr), NASA($150K/yr), AFOSR($50K/yr), NWS($75K/yr)

8. Signatures:

Faculty Investigators:	Date:
Carlton W. Ulbrich	5/2/89
M. F. Larsen	5/2/89
Lewis M. Duncan	5/3/89
L. S. Miller	5-3-89

Department Heads:	Date:
Peter J. McMullin	5/3/89

Deans:	Date:
Bobby G. Wilson	5/3/89

1989-90 Cutting Edge Research Investment Fund Proposal

1. Period of funding requested: One year ___ or Two years x

2. Second Century Area: (Check the focus area you desire for your proposal's first level review)
   ___ Agriculture and Food x Engineering and Basic Science ___ Marketing and Management
   ___ Quality of Life ___ Textiles

3. Title of Proposed Project An Advanced Meteorological Radar Facility for Research and Instruction in Atmospheric and Space Physics

4. Proposed Budget

	Cutting Edge 89-90	Cutting Edge 90-91 (2 year prop. only)	Other Funds
Personnel:			
Classified			
Non-classified			
Graduate student(s)			
Undergraduate students			
Fringe benefits			
Travel			
Materials and Supplies			
Equipment	$80,000	$80,000	
Technical support			
Other (explain)			
Totals	$80,000	$80,000	$710,000

5. External support (As listed in budget under 'Other Funds'): Ratio of External to Internal 4.4
   A. Source(s) NSF($80K/yr), NASA($150K/yr), AFOSR($50K/yr), NWS($75K/yr)
   B. Availability: Immediate x, or later (give date) _____
   C. Guarantee:(check only one) Absolute___, Highly likely x, Probable ___, Possible ___

This space is for first-level reviewer's evaluation:

A.	Economic Development impact	Max 30	This project ___
B.	Quality and professional merit	Max 25	This project ___
C.	Demonstrated leverage for external funding	Max 20	This project ___
D.	Enhancement of CU's research capacity	Max 15	This project ___
E.	Contribution to 2nd Century focus area(s)	Max 10	This project ___
		Total	This project ___

Of the ___# proposals from the _____ focus area, this proposal ranks ___

This space is for university-level reviewer's evaluation:

6. Economic development linkage: (Briefly state the link to economic development in SC)

One of the possible economic benefits to the state of South Carolina through development of the kind of radar facility described below would be the formulation of techniques for detection of severe weather events such as flash flooding, tornadoes, thunderstorms and hail. There is a critical need for such a system in the upstate of South Carolina and this need was clearly demonstrated during the recent 4 April 1989 severe weather episode which involved four tornadoes in the Anderson area as well as local flooding in several upstate areas. This event has been documented by individuals at the National Weather Service office in Greer and they have shown how improved radar detection of these events would help to protect people and property from the damage that these severe weather episodes create. At present there is no adequate method anywhere in South Carolina of remotely detecting severe weather. The nearest weather radar to the upstate region is the National Weather Service radar in Athens, GA but it provides radar information only once every twenty minutes. Clearly, this is insufficient to provide storm warnings on a timely basis which are needed by all the citizens of South Carolina.

Another possible benefit to South Carolina which would result from installation of the proposed radar facility would be the ability to more accurately monitor rainfall in the drainage basin of the Savannah. The present radar data available from the National Weather Service radars are inadequate for this task; the NWS recognizes this fact and the need for improved systems for measurement of precipitation amounts. The proposed radar will have the capability of measuring these amounts accurately thus providing the data which are needed by the South Carolina Water Commission for management of the state's groundwater resources.

7. Follow-on research opportunities: (Summarize the type and probability of follow-on work)

Upon completion of the proposed radar facility it will be used to pursue the kind of research which has been conducted by Clemson atmospheric scientists for more than fifteen years under sponsorship from several external funding agencies. The location of the radar at Clemson will considerably enhance the ability of Clemson scientists to attract sustained funding for their work from agencies such as NSF and NASA. It will also act as a strong magnet for the attraction of outstanding atmospheric scientists to work at Clemson. Furthermore, opportunities will become available for Clemson to participate in international space physics experiments such as the forthcoming NASA Tropical Rain Measuring Mission and the Earth Observing System. Both of these large scale experiments are scheduled for initiation in the decade of the 90's. The probability that Clemson scientists will be involved in these experiments is high since they have been conducting research sponsored by NASA for about a decade. Finally, cooperative research with scientists from other departments in the university and with individuals from the National Weather Service in Greer and in Columbia is highly likely.

8. Enhancement of research capacity: (Briefly state how project will enhance CU's research capacity)

The acquisition of the proposed equipment will permit development of an advanced research radar facility equal in quality to any in the eastern half of the United States. Location of this facility at Clemson University will make possible the conduct of experiments supported by national funding agencies which will attract scientists from national res[illegible] organizations for participation in the research. It will also provide a platform which faculty can use to conduct experiments which cannot presently be undertaken at Clemson or in South Carolina. In fact, faculty have in the past travelled to remote facilities at several locations around the world in order to conduct their research sponsored by external agencies. Furthermore, there does not now exist any opportunity for training of graduate students at Clemson or, for that matter, anywhere in the southeast. To accomplish such training at present it is necessary to send students to the aforementioned facilities for extended periods of time and this is clearly inefficient, time consuming, expensive and extends the period of time a student must spend in graduate school pursuing a degree.

9. Attach no more than two single-space pages explaining the proposed project.

9. Explanation of the Proposed Project

This is a proposal for the development and installation of a state-of-the-art meteorological research radar in the upstate of South Carolina. There is a critical need in the upstate region for such a system and this has been plainly apparent and well documented by the National Weather Service Office in Greer for many years. The upstate region experiences frequent episodes of severe weather events and the proposed meteorological radar facility would permit research into the development of advanced signal processing and remote sensing techniques which could considerably enhance our ability to detect these phenomena.

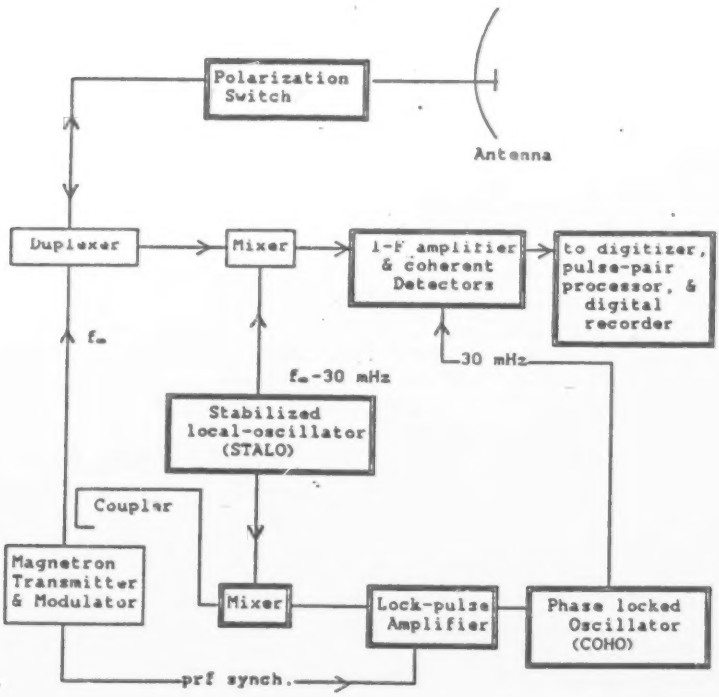
The atmospheric physics group in the Department of Physics and Astronomy at Clemson University has many years of experience in the quantitative observation of meteorological events using weather radar. The group has had considerable success over the years as an experimental program and has attracted funding for their research from a variety of agencies including the National Science Foundation, the National Aeronautics and Space Administration, the Air Force Office of Scientific Research, and others. The complete absence in the southeast United States of any advanced equipment of the type described in this proposal has meant that Clemson atmospheric physics researchers have had to travel to remote facilities at locations around the world to conduct their research. Examples of these sites include the National Astronomy and Ionosphere Observatory in Arecibo, Puerto Rico, the National Hail Research Programs in Colorado, the NASA Wallops Flight Facility in Wallops, VA, the Flatland and CHILL radars at the University of Illinois, the NSF radar in Søndre Strømfjord, Greenland, and others. The prolonged stays at these facilities of Clemson faculty and graduate students is expensive and time consuming and can be, at times, a gamble when the meteorological phenomena being investigated are highly variable in space and time (e.g., thunderstorms and other similar events). In addition, graduate students at Clemson who work on these projects gain their first experience with data taking and radar instrumentation when they arrive at the facility. Clearly, these students would be much better prepared for research after they leave Clemson and faculty would be able to conduct research much more efficiently if the instrumentation they use in their research were more readily available than it is at present.

To improve the local experimental environment, Clemson faculty have been working with representatives at the National Weather Service with the goal of establishing a research radar at the NWS office in Greer. The advantage of having the radar located at that office is that the NWS already has an individual working at that office who is trained in the operation and maintenance of such equipment. The Weather Service will cooperate in this venture by providing the basic radar platform including the tower, the transmitter/receiver and the antenna. The university has agreed to pay for shipment of the radar to the Weather Service office, for installation of a concrete pad on which the radar would be placed, and for yearly maintence costs. This proposal would provide the equipment shown on the block diagram below which would be necessary to bring the radar to the point where it can be considered a first rate meteorological research radar. An agreement has already been reached with the Weather Service that the equipment would be the sole property of Clemson University and if the NWS office should be closed at any time in the future or if they feel that they no longer have need for the radar, then and it may be moved to any location that the university feels is appropriate. This may also include leaving it at the jetport if an arrangement can be made with the airport authority.

Specific details regarding the equipment requested in this proposal are as follows. Three categories of equipment are involved and are shown in the accompanying diagram by blocks enclosed by double lines. The first consists of conversion of the transmitter/receiver to a coherent system to extract Doppler information from weather echoes. This step is essential for detection of motion fields, especially those associated with thunderstorm circulations and possibly tornadoes. Secondly, the output data stream will be digitized and recorded using modern digital recording methods so that they can be used in subsequent analysis using existing computer facilities in the Department of Physics and Astronomy provided by a grant from the National Science Foundation. Thirdly, a fast polarization switch will be added to the antenna feed structure to allow for virtually simultaneous measurements at

two orthogonal polarizations. The latter will permit detailed examination of storm precipitation and cloud particle microphysics and will also allow for much improved ability to measure rainfall amounts quantitatively. Clemson scientists have considerable experience with this type of instrumentation for observation of meteorological phenomena. They were among the first to recognize the potential for dual-measurement methods for improved measurement of precipitation and have pioneered in the development of algorithms involving this technique.

Upon completion of the installation of the radar and these components, it will represent one of the most advanced radars in the eastern half of the United States, the only one of its kind in the southeast region, and the only research weather radar available for remote observation of meteorological phenomena in the state of South Carolina. Its presence in the upstate would considerably enhance the research capabilities of a nationally recognized Clemson atmospheric physics group, and would attract scientists from a variety of other disciplines who would find the radar valuable in their work, such as, the agricultural, environmental and hydrogeological fields. Finally, the acquisition of such a radar would be ideal for participation by South Carolina scientists in forthcoming space physics and global system science experiments to be conducted in the 1990's by NASA and other agencies.



REPORT ON TORNADOES AND ... THUNDERSTORMS IN UPSTATE SOUTH CAROLINA
ON MAY 5, 1989

NATIONAL WEATHER SERVICE OFFICE
GREENVILLE - SPARTANBURG AIRPORT
GREER, SC

Wayne A. Jones
May 15, 1989

The second major severe weather outbreak of the year affected Upstate South Carolina on Friday, May 5, 1989. This outbreak also caused widespread damage - and unfortunately loss of life and injury. There were 2 fatalities and 35 injuries near Chesnee in Spartanburg county when an F4 tornado touched down at 620 PM. In retrospect the first outbreak in April probably was fortuitous. Attention and preparedness were heightened, and in combination with warnings and statements may have served to hold down loss of life.

This report will document actions taken by the WSO Greenville - Spartanburg staff, the weather events of that day, the effectiveness of the warning system, and resulting damage and storm effects. We will again look at weaknesses in our system and apply knowledge gained to future operations.

PRIOR TO THE OUTBREAK

Thanks to a good DAY 2 outlook from the National Severe Storms' Forecast Center (NSSFC) we adjusted staffing Thursday for Friday's weather. On Friday double coverage was provided during the day by the regularly scheduled day shift and by the supernumerary shift. The Official in Charge changed his Friday work from a normal administrative workday to evening shift in order to provide double coverage then.

By Friday afternoon a cold front was approaching Georgia, the Upstate, North Carolina, and Virginia. An old thunderstorm outflow boundary stretched from ATL to GSP to RDU. A vorticity maximum over AL was positioned to be a significant force in the afternoon and evening weather across the southeast, and an intense surface pressure couplet developed as a result. At 221 PM EDT NSSFC issued Tornado Watch Number 183 for parts of AL, GA, and SC effective from 245 PM until 900 PM. This watch took in most of the counties in the Upstate. A rather intense meso-low was analyzed near ATL by that time.

MID TO LATE AFTERNOON

At about 230 PM EDT the GSP staff turned on "SVRWX" - an AFOS procedure which increases the number of alerted and alarmed products at the public console. Severe thunderstorm activity began near the AL/GA border in mid-afternoon and progressively moved toward the Upstate. ATL and then AHN began issuing warnings for their counties and the Kavouras RADAR imagery from WSO AHN depicted an impressive line of convection across northern and central Georgia. An odd difference between this outbreak and the April 4 outbreak was the lack of lightning activity. The LDS chart showed nothing unusual - in fact cloud to ground lightning was minimal.

We reduced the programming on NOAA Weather Radio and inserted the Tornado Safety Rules tape upon watch issuance. We attempted to alert the Amateur Radio Spotter groups through our normal call list. However, their "Hamfest" was underway and it was not possible to reach them directly. Fortunately we had made arrangements the day before to request the county sheriff department to notify them for us should contact not be possible. We did this, and a somewhat limited amateur network was activated (many were involved in the Hamfest). An amateur arrived at the office at 5:40 PM and operated net control from here. Other types of spotter groups functioned normally.

Calls were made to the two CPCS-1 EBS stations to advise of the watch and the possibility of many warnings. WSPA Radio understood, but WFBC did not have anyone familiar with local EBS procedures on duty. As a result, warnings which affected their operational area were not broadcast over EBS. During the April outbreak they had broadcast warnings as requested.

Statements were written by WSO GSP at 245 PM and 345 Pm EDT after the first watch had been issued. The 245 PM statement discussed some shower and thunderstorm activity currently over the area, and mentioned that severe thunderstorms and tornadoes would be possible later in the afternoon and evening over the Upstate. The 345 PM statement indicated that activity currently in GA could move into northwest SC later, and urged people to monitor NWR for later information.

At 433 PM EDT NSSFC issued a second watch extending tornado watch coverage farther to the north and east. This watch took in the remaining Upstate counties, and contained the "enhanced wording option." Paragraph D of this watch outlined the concerns of the SELS forecaster, and the weather events which followed were almost exactly the scenario forecasted. NSSFC also did an outstanding job after the watch issuance by providing updates via SWOMCD's, status reports, and a phone call to CAE which information was forwarded to us.

Additional SPS's were issued by our office outlining the urgency of the weather situation. A 435 PM EDT statement described the line of severe thunderstorms moving across GA, indicated that warnings were being issued in GA for the storms, and projected an Upstate arrival of between 500 PM and 600 PM EDT. A statement released at 515 PM EDT was issued primarily to confirm that all Upstate counties were under a tornado watch and projecting severe thunderstorms into Anderson, Abbeville, and Greenwood counties by 545 PM EDT.

We had decided that 3 person coverage was required again for this episode and held the day shift over. Because of the obvious urgency of the developing situation, calls were made to county Emergency Preparedness offices between 420 PM and 509 PM. This is not something we do for each tornado situation - but is an option for the duty personnel. Normally we will make calls when the risk is higher than "Slight" and tornado activity is present upstream and moving toward the Upstate - and we have the time to do it.

As on April 4, RADAR imagery became a problem. During the period the activity was affecting WSO AHN's County Warning Area and afterward - updates were only available to our office at 20 to 30 minute intervals. On May 5 this directly resulted in negative lead time warnings in two cases - and shorter lead times than on April 4 in others.

THE WARNINGS

The northern end of the line of severe thunderstorms had become obscured from our limited RADAR view at about 430 PM as it moved into the ground clutter pattern of the AHN RADAR. Since only a low level PPI presentation is available on Kavouras imagery, and since we were getting updates at about 20 to 30 minute intervals, our perception of the activity there became distorted. A 500 PM WWAMKC described a very strong cell in Madison county GA which would be moving through Anderson county and into southern Greenville county. At this point we decided that a warning was in order for Oconee and Anderson counties - and we tried to determine if a tornado warning or severe thunderstorm warning would be better. An attempt was made by calling both CAE and SELS to obtain satellite interpretation of whether a tornado warning was justified. At this point we discovered that the SELS number we had available was outdated. We lost a few minutes of valuable time because of this. RADAR imagery at this time still showed the squall line just leaving the ground clutter pattern - and we apparently still had plenty of time to work with before a warning (with good lead time) would be necessary (a half hour or so).

However, a small thunderstorm echo had developed 15 miles or so ahead of the line near the Stephens county, GA/Oconee county, SC border. The echo appeared to be nothing more than a level 3 and 4 storm while the main squall line showed bright red (level 5). At 519 PM EDT a call was received from WSO AHN reporting of a possible tornado in Stephens county GA. We issued a tornado warning at 521 PM for southern Oconee and Anderson counties based on this report. It was not clear to us at this point whether an actual tornado had been produced by the "small" thunderstorm, or whether severe weather was occurring with the line. To complicate matters, a second reported tornado - with severe damage and injuries - was received from Stephens county at about 530 PM. This turned out to be an inaccurate report (there was only one tornado which caused the severe damage), but it coincided with passage of the main line.

At 523 PM Oconee county reported a possible tornado near Westminster, and at 524 PM we issued a tornado warning for Pickens county based on that report. It was now becoming clear to us that something was going on ahead of the line - but RADAR imagery was so poor that we were unable to get a handle on the situation.

The few RADAR updates available showed 2 main cells within the squall line. One was in the northern section of the line and another just south of it would affect parts of some counties in the Upstate. The smaller cell ahead of the line was still present and seemed to be accelerating even farther out ahead of the line. At 536 PM we issued a Severe Thunderstorm Warning for Abbeville county based on the RADAR and numerous reports of wind damage in Georgia with the line. At 551 PM we issued a Tornado Warning for Greenville county because of the threatening northern end of the line which had produced multiple reports of tornadoes.

The southern counties in our area were beginning to be affected by the lagging portion of the squall line. Severe thunderstorm warnings were issued at 601 PM for Greenwood and Laurens counties. At 603 PM at WWAMKC was received which "fed back" some of the reports we had been transmitting via LSR's and SVS's. One of those reports was "severe tornado damage" 10 south of AND at 545 PM (which turned out to be wind

damage). The WWA said that cell would be moving through Spartanburg and Cherokee counties in SC, and Henderson, Polk, and Cleveland counties in NC by 2245Z. Apparently, the WWA meant multiple cells because it would not be possible for one cell to take that track. At any rate, it implied that the cell which produced the Anderson damage would move through Spartanburg and Cherokee counties. Actually, the tornadic thunderstorm was out ahead of the line and was almost across Greenville county at that point. At 615 PM we received a report of a tornado (actually a funnel cloud) at Boiling Springs in Spartanburg county and immediately issued a Tornado Warning for that county. We included Laurens county purely because of the impression of RADAR imagery. A very bright and large echo was moving directly toward the city of Laurens,and we felt we could take no chances in such a volatile situation. The "severe damage" report back in Anderson county also influenced this decision.

At 636 PM we issued Severe Thunderstorm Warnings for Union and Cherokee counties because of the consistent reports of damage and RADAR imagery.

At 642 PM we sent a CAEADAGSP addressed to CLT advising of tornado reports from "the cell ahead of the line." At this time the cell was crossing Rutherford county headed toward Cleveland county.

Attachment 1 is a list of warnings with calculated lead times.

SEVERE WEATHER AND RESULTING DAMAGE

There were 3 tornadoes in South Carolina. Two resulted from the tornadic supercell which moved across the Upstate ahead of the main line of activity. The third was associated with the dominant cell in the northern end of the line which immediately followed the supercell. Accompanying wind damage with the passage of the line was not extensive as compared to the April 4, 1989 storm. However, there were several areas of downburst which produced concentrated wind damage. There were only a few reports of large hail, but there was some very intense rainfall - apparently associated with the supercell - which caused some brief, localized flooding in Oconee and Pickens counties. Attachment 2 is a map of the activity, and attachment 3 is a list of severe weather reports which have been documented so far.

The first severe weather occurred in Oconee county at 515 PM EDT and the last was reported from the lagging southern end of the line at 705 PM at Clinton in Laurens county.

The first tornado in South Carolina was the Toccoa, GA tornado. It had diminished to an F1 storm by the time it crossed the border at about 515 PM EDT. The storm moved about 5 miles into the state before dissipating. Damage was mostly to trees but there was some mobile home and light structural damage in the community of Madison. The parent thunderstorm continued to cause some minor wind damage into the town of Westminster.

The second tornado occurred at about 540 PM, also in Oconee county. However, this tornado was associated with the main squall line. An intense cell in the northern end of the line produced an F2 storm which initially touched down at Tamassee and moved to near Salem before dissipating. Many large trees were snapped off and blown over. The DAR school at Tamassee suffered the most extensive damage - mostly as a

result of trees falling onto the buildings. There was some structural damage in spots not well protected by the thick, hardwood forest.

The tornadic supercell ceased tornado production for just about 1 hour as it moved across Pickens and Greenville counties. There were a few reports of wind damage in each of these counties, but there was only F1 damage. There was a delayed public report of a funnel cloud in northern Greenville county. This sighting was made at 600 PM - about 20 minutes before the tornado touched down in northern Spartanburg county.

The tornadic supercell began to curve very slightly toward the left (more northeast). This turn seems to be coincident with the resumed tornado production. The other elements of the squall line continued a generally eastward movement. Even the dominant cell in the northern end of the line which produced the second Oconee tornado moved toward the east.

The Chesnee tornado was observed as a funnel cloud as it passed near the town of Boiling Springs at 615 PM. This was observed and reported by a volunteer fireman. The tornado touched down at 620 PM halfway between Boiling Springs and Chesnee (6 miles southwest of Chesnee) and moved along a 10 mile path through the western sections of Chesnee, across the extreme northwestern corner of Cherokee county, SC and then into Rutherford county, NC. The tornado crossed the NC border at approximately 635 PM. At the point of touchdown the storm was about 400 yards wide. It gradually expanded to about 1 mile in width as it moved west and northwest of Chesnee. The storm produced F4 intensity damage not long after touchdown - but in most places strong F3 damage was observed.

A man was killed almost at the point where the tornado touched down. He and his wife heard the report of the funnel cloud at Boiling Springs and laid on the floor of their house. The house was about 75 percent destroyed and the man died when the chimney fell on him. A woman was killed near the same location when her mobile home disintegrated. There is some evidence she was attempting to leave the mobile home when the storm struck. 35 people were injured in Spartanburg county.

In Spartanburg county the storm destroyed 13 mobile homes and damaged another 5. 25 houses were destroyed and 53 others received damage. 3 commercial buildings were destroyed. Damage in Spartanburg county has been placed at about $2.5 million including real property and utility damage. In Cherokee county 4 mobile homes were destroyed, 4 houses received severe damage, and 8 outbuilding were destroyed. Damage to real property there was placed at $250,000.

EFFECTIVENESS OF THE WARNING PROGRAM

As in the April 4, 1989 outbreak the basic structure of the warning program and its various elements was found to be quite sound. When a dangerous weather situation such as this is properly analyzed at all levels and the results of that analysis are communicated to local officials and to the public - saved lives result. One department head from the city of Greenville put it quite eloquently a week after the May 5 outbreak when he said, "One would have had to be hiding with no radio or TV to not know what kind of weather situation was developing that afternoon."

There are some basics of severe weather operations that must not change - regardless of the sophistication of the technology that's forthcoming. Those things are:

1. Offices must be willing to communicate with each other. Ground truth weather which is rapidly moving from one area of responsibility to another must be followed and communicated to the next downstream office. Because Athens did their job in this case - we were able to better do ours.

2. An office must tell their public what's going on. Sometimes warning after warning is issued without any hint of what the storms have actually produced. When this is done the public is left with the perception of a very mechanical thing and often don't believe the warning. In many cases TV and radio personalities pass these warnings along in the same mechanical, non-enthusiastic way. When reports are frequently transmitted via short real-time LSRs and SVSs - warnings are "legitimized" in the public mind and a sense of urgency develops. People perceive themselves at risk because they realize something is actually happening. The warning system then works - even if the warnings don't have much lead time - because people can follow the movement of the weather."

3. Ready-Set-Go is already alive and well! The Outlook, Watch, and Warning concept has been getting better and better and will continue to do so. Any deviation from this framework of the warning system is apt to cause confusion for the next 30 years. Storm surveys following both Upstate outbreaks this year convinced me that people mostly understand the Watch/Warning system and how it works. They heard the outlook of chances of severe weather later those days, heard the watches, heard statements talking about very dangerous situations, and in most cases - heard the warnings. Many, many people took action based on the warning and the advice contained in the warning. Many people described taking the protective action recommended in the warning bulletins many minutes before the storm became visually apparent." It becomes obvious that we should build on the current warning framework rather than redesigning it.

4. Warnings for specific counties with reasonably short lead times should continue to exist in that context. This contributes to the sense of urgency described above. It would seem that lead times of more than about 1/2 hour would almost be too much.

5. We have been very busy training spotters in our 10 counties this year. That must always be a priority within the NWS. Spotter training combined with well designed preparedness work in the local community will continue to save lives. Along the same lines, close personal contact with local government officials permits a more efficient methodology during emergency situations.

MEDIA COVERAGE OF THE EPISODE

This event once again occurred near the evening news time period. Many people were tuned in to TV and were able to hear just about a blow-by-blow account of the weather system as it marched across the Upstate. There is no doubt that this once again resulted in lessened casualties.

statements early in the [illegible]. Even those utilizing private weather services passed along NWS information very quickly.

EBS was activated in part of the Upstate. WFBC, which has responsibility for the western part of the area, failed to activate EBS during this episode. The person on the board was apparently not familiar with procedures and also misunderstood some information from our initial call. She assumed that we would call each time a warning was issued. WSPA activated their operational area for all warnings.

Print and broacast media coverage of the April episode relayed the proper preparedness messages to the public. Naturally, that contributed to the heightened awareness previously mentioned.

NOAA WEATHER RADIO

NWR again functioned superbly during this major episode. We were able to get the safety rules into the cycle long before the storms struck, and we reduced programming until we had nothing but warnings, statements, and the safety rules in the cycle.

Once again we simply had no time to "clean up" all the warnings with statements consolidating the warning information. The broadcasted warnings I managed to monitor, however, were very well done while conveying that important sense of urgency.

PROBLEMS AND WEAKNESSES

Not really a problem, but something important to note is the fact that 3 people were completely swamped with work maintaining adequate warning for 10 counties. Even had NWR responsibilities been removed, our time would have been taken by the remaining work. We also had an amateur radio operator in the office - just as busy as we were.

NAWAS and the SLED communications circuit worked smoothly during this episode. It is still not known what caused NAWAS to fail on April 4 - but it apparently was transitory. The SLED circuit was taken down for routine maintenance by the state on April 4 but worked correctly on May 5. We have received no complaints about any communications problems.

One can only surmise about the difference better RADAR equipment would have made during this outbreak. We issued 6 county warnings for tornadoes during this event. While each "technically" verified because severe weather of some sort occurred after the warning was issued - only 2 counties which were warned for tornadoes had one occur. In one case, a tornado occurred before the warning was issued and another tornado occurred about 25 minutes later. In the other case the tornado touched down only 2 minutes after the transmit time of the warning. And a tornado occurred in one county that was not warned for tornadoes - a Severe Thunderstorm Warning was issued for that county, for a different cell, a few minutes after the tornado hit.

We do know that the tornadic supercell was masked from the AHN RADAR by intervening echoes as it moved into the Upstate, and that no existing RADAR is correctly positioned to have adequately detected that storm. We also know that we were getting updates from the AHN RADAR at 20 to 30

minute intervals (a total of 4 frames during the episode). Because the tornadic supercell was accelerating away from the squall line, and because it was displayed as a level 3 storm at lower elevations; and because we could not evaluate the mid and upper levels of the storm, our timing was confused and we focused too much attention on the squall line thunderstorms.

SUMMARY

For the second time this year our local area has been subjected to one of the most extreme and violent types of weather found in the United States. Looking at the decade of the 1980's - the stories of strong and violent tornadoes have been told in the southeast US - especially the Carolinas - with alarming frequency. In that sense, the Upstate has been fortunate to have been spared for so long.

Considering the limitations of technologies available at our local office - the NWS served the public well in both cases. Besides the actual issuances described above, and the meteorology which was in place on those days, and the strengths or limitations of various pieces of equipment - there is a point which needs to be considered.

There are some important elements of severe (non-routine) weather operations which must be continually developed and nourished. Those are intangibles such as personnel being willing to deviate from the routine work to focus on a developing situation. And working hard to follow each small clue as a storm system approaches the area of responsibility. Fostering close relationships with people on the local level. And disseminating as much information as possible to the public and to downstream offices.

ATTACHMENT 1

WARNINGS, VALID TIMES, AND LEAD TIMES

COUNTY	WRNG	VALID TIME	FIRST EVENT	TIME	LEAD TIME
OCONEE (SRN)	TOR	5:21 PM-6:30 PM	TORNADO	5:15 PM	-6 MIN
		2ND	TORNADO	5:40 PM	19 MIN
ANDERSON	TOR	5:21 PM-6:30 PM	HAIL	5:42 PM	21 MIN
PICKENS	TOR	5:24 PM-6:30 PM	WIND DMG	5:45 PM	21 MIN
ABBEVILLE	SVR	5:36 PM-6:45 PM	WIND DMG	5:50 PM	14 MIN
GREENVILLE	TOR	5:51 PM-7:00 PM	WIND DMG	6:10 PM	19 MIN
LAURENS	SVR	6:01 PM-7:00 PM	WIND DMG	6:35 PM	34 MIN
GREENWOOD	SVR	6:01 PM-7:00 PM	WIND DMG	6:08 PM	7 MIN
SPARTANBURG	TOR	6:18 PM-7:15 PM	TORNADO	6:20 PM	2 MIN
LAURENS	TOR	6:18 PM-7:15 PM	WIND DMG	6:35 PM	17 MIN
		SVR ALREADY IN EFFECT			
CHEROKEE	SVR	6:36 PM-7:45 PM	TORNADO	6:33 PM	-3 MIN
			WIND DMG	6:50 PM	14 MIN
		SVR ISSUED FOR DIFFERENT STORM THAN TORNADO			
UNION	SVR	6:36 PM-7:45 PM	WIND DMG	6:50 PM	14 MIN

The first event times are the times of the first event meeting severe weather criteria in each county. In most cases severe weather spread over the remainder of the counties. Some communities received more warning than indicated for the county as a whole. The Chesnee tornado was on the ground for about 15 minutes in South Carolina, for example.

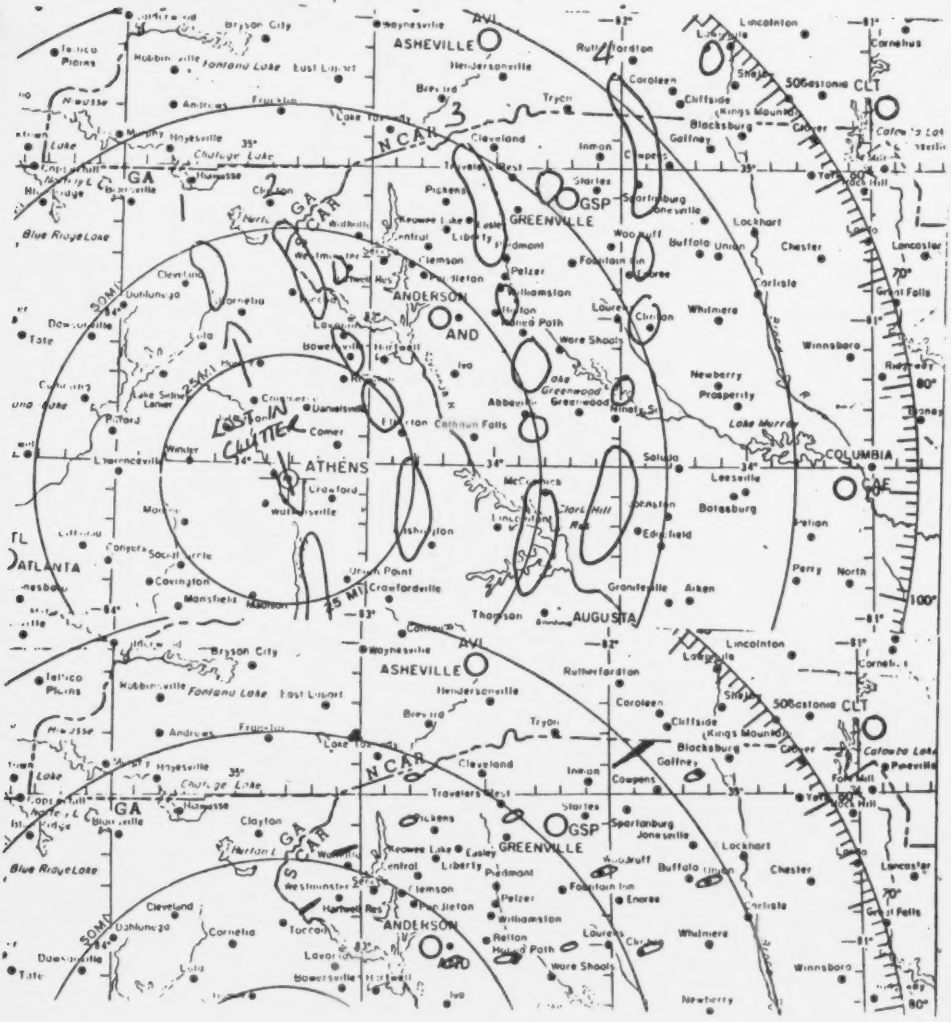
ATTACHMENT 2

THE TOP MAP ROUGHLY DEPICTS RADAR IMAGERY FROM WSO AHN.

THE BOTTOM MAP SHOWS DAMAGED AREAS IN THE UPSTATE..

TORNADO PATHS SHOWN AS: /

SIGNIFICANT DOWNBURST SHOWN AS: O



CACHMENT 3 - SEVERE WEATHER EVENTS ON MAY 5, 1989

:15 PM	TORNADO	F1	MADISON	OCONEE	4		0
:25 PM	TSTM WINDS		WESTMINSTER	OCONEE	3		0
:40 PM	TORNADO	F2	TAMASSEE TO NEAR SALEM	OCONEE	4 OR 5		0
:42 PM	HAIL	0.75	ANDERSON	ANDERSON	0	0	0
:45 PM	TSTM WINDS		NINE TIMES	PICKENS	3		0
:45 PM	TSTM WINDS		10 SOUTH ANDERSON	ANDERSON	4	0	0
:50 PM	TSTM WINDS		ALL	ABBEVILLE			
:00 PM	TSTM WINDS		TABLE ROCK STATE PARK	PICKENS	?	0	0
:10 PM	TSTM WINDS		HONEA PATH	ANDERSON	4		0
:10 PM	TSTM WINDS		PARIS MOUNTAIN/5 N GREENVILLE	GREENVILLE	?	0	0
:12 PM	TSTM WINDS		FOUNTAIN INN	GREENVILLE	3		0
:08 PM	TSTM WINDS	.	WEST SIDE GREENWOOD	GREENWOOD	5	0	0
:20 PM	TORNADO	F4	5 SW CHESNEE	SPARTANBURG	6 OR 7	6	2
:30 PM	TORNADO		XTRM NW CORNER	CHEROKEE	5		0
:35 PM	TSTM WINDS		WESTERN	LAURENS	4?	?	0
:30 PM	TSTM WINDS		SOUTHERN	GREENWOOD	?	?	0
:40 PM	TSTM WINDS		WOODRUFF	SPARTANBURG	3		
:50 PM	TSTM WINDS		UNION	UNION	4		0
:50 PM	TSTM WINDS		GAFFNEY	CHEROKEE	3 OR 4		0
05 PM	TSTM WINDS		CLINTON	LAURENS	3		0

MIKE,

FROM REPORTS I'VE HEARD, AND LOOKING AT RADAR LOOP – THE STORM THAT PRODUCED THE TOCCOA + CHESNEE TORNADOES PASSED OVER NORTHERN GVL COUNTY – NEAR FURMAN. IF IT HAD GOTTEN ONE ON THE GROUND ...

YOUR IN PUT TO THE ARTICLE IN THE PIEDMONT WAS SUPERB. WE ALSO APPRECIATE YOUR KIND WORDS + YOUR STAND RE THE LOCAL WEATHER NEEDS.

LET ME KNOW WHEN I CAN HELP YOU.

WAYNE

Weather Plan May Leave Carolinas Area Vulnerable

By ED MARTIN
Staff writer

A $1.4 billion National Weather Service modernization plan would not improve storm forecasts for 2 million people in the heart of the Carolinas, and could even disrupt systems that already warn them of violent weather, say critics.

The plan, to be phased in by the middle 1990s, depends heavily on sophisticated Doppler radar that can look inside violent storms to detect the birth of tornadoes like those that killed eight Piedmont Carolinians in May.

But a number of scientists, local officials and others say the government has oversold the radar's capabilities to persuade Congress to pay for the modernization.

They say a swath of the Carolinas from the Georgia border through Greenville-Spartanburg, Gastonia, Charlotte and as far east as Rowan, Stanly and Union counties would lie outside the effective range of Doppler installations, affecting an estimated 2.3 million people.

And, because the plan also calls for closing local weather offices — Charlotte's would close and the area would be served from Columbia — critics predict the collapse of the existing system of spotters and amateur radio operators who provide eyewitness storm reports.

"When I heard what they planned to do, it was almost like somebody told me I had cancer," said Wayne Boggan, Mecklenburg emergency management director.

Adds Kay Boylan, WSOC television meteorologist: "There are avenues where we are going to be putting the public at risk, and not just here in Charlotte."

WSOC-TV, channel 9, and WBTV, channel 3, have Doppler radar, adapted from aviation weather avoidance radar. It lacks the range and precision of the proposed weather service systems, and only the weather service can issue official violent weather watches and warnings.

See FORECASTING Page 6A

Weather Eye: Blind Spot For Violent Storms?
Hickory
Charlotte
Because radar signals travel in a straighter line than the curve of the Earth, the farther from their source, the higher and less precise are readings. Some scientists say radar beams at 125 miles — the range claimed by proponents of the system — would be at 10,000 to 14,000 feet, too high to detect violent, ground-level storms.
10,000 - 14,000 feet

Forecasting System Falls Short

Continued From Page 1A

Weather service officials in Washington stand by the modernization plan, but concede some criticisms hit the mark.

One is that the planned Doppler radars could not detect the small tornadoes, most common in the Carolinas, beyond 30 to 40 miles, far less than the 125-mile range widely quoted by the weather service.

"That's true," said Lee Boezi, director of the weather service's transition program in Washington. "You run into range problems with low-level, small tornadoes."

The so-called Next Generation Radar — "NEXRAD" — and modernization plan calls for paring 250 weather service offices nationwide to about 115. Five Carolinas offices would close. Offices in Raleigh-Durham, near Morehead City and Wilmington in North Carolina, and Columbia and Charleston in South Carolina would be upgraded.

Charlotte and the area around it would be covered by the Columbia NEXRAD installation, about 90 miles south and possibly beyond the radar's Doppler effect.

"We were originally told the [illegible] adviser to the U.S. House Science subcommittee on transportation, aviation and materials, chaired by Rep. Tim Valentine, D-N.C. "Now we're told the effective range is only 30 to 50 miles."

A weather service map of [illegible] over the Carolinas shows them in east Tennessee, southwest Virginia, near Raleigh and New Bern, south of Wilmington and near Beaufort, S.C., and Columbia.

Curt Stanford, technical adviser to the U.S. House Committee on Science, Space and Technology, [illegible] Radar signals curve [illegible] runs than the Earth's surface. Stanford. At 125 miles, the range the weather service says would provide blanket coverage of the United States, Doppler radar would reflect nothing below about 2 miles altitude.

"When funnel clouds are formed," said Mecklenburg's Broome, "it's not 10,000 feet up in the air we're concerned about."

Broome cautioned weather service officials in a recent letter that two nuclear power plants are within 20 miles of Charlotte.

"We have to have accurate weather data to set up evacuation zones," he said in a subsequent interview.

Ed Brotak, assistant atmospheric sciences professor at UNC-Asheville, said the plan would leave gaps in Western North Carolina, too. "I went to a National Weather Association meeting in Denver last fall. The NWS showed a nice map of Doppler, but Asheville was not covered at all."

In Cary, Herb White, chairman of the regional National Weather Service Employees Organization, said the plan would scatter Doppler sites too thin.

"Some large areas like Charlotte would be relatively unprotected by the Doppler umbrella," he said. [illegible] vational radar signals, but not the improved Doppler technology, and that's what the modernization plan is all about."

Brotak said the current plan is shaped by political and budgetary considerations, more than technological factors.

"In the 1980s, the Reagan administration targeted the weather service for cutbacks and privatization," Brotak said. "It has lost employees now than 20 years ago."

In Charlotte, the number of employees has dropped from eight to five and a student volunteer sometimes augments the staff.

Today weather service employees and congressional sources also say the plan was influenced by the Defense Department, one of three agencies involved in drawing it up. The others were the weather service and the Federal Aviation Administration.

Proposed Doppler sites in the Carolinas would provide overlapping coverage for military installations such as Seymour Johnson Air Force Base near Goldsboro and coastal Marine bases, while leaving some civilian areas unprotected, they say.

"This is another effort to reduce programs the public depends on," said Strickland. Valentine and his science subcommittee will fight closings, said Strickland.

"People get up every morning and ask, 'What's the weather like?' " he said.

In Silver Springs, Md., weather service headquarters, officials are trying to defuse opposition. They say the plan must be field tested and Congress will act as watchdog throughout its implementation. Initial hearings will probably begin next summer.

But the weather service's Boezi defends the plan, saying it is still sensitive.

Controversy over the Doppler [illegible] that the plan also calls for new satellites, advanced computers, faster communications and automated collection of such information as temperature, precipitation and cloud cover, Boezi said.

"People equate service to the mere presence of a federal office," said [illegible] certify to Congress that the level of service will be improved, the closings are not going to happen."

Weather Offices To Close

THE CHARLOTTE OBSERVER
FEB 01, 1989 Section B
page 1 and page 4

Charlotte Could Face Loss In 2 Years

By ED MARTIN
Staff Writer

Charlotte and two or three other N.C. cities might lose their National Weather Service offices in two years, authorities in Washington said Tuesday.

The closings would stem from efforts to pare the federal budget deficit and to modernize the service.

"In the reorganization, they will cut out about 130 field offices nationwide," said Peter Nuhn, Washington spokesman for the union that represents weather service employees nationwide.

Weather service officials said a list of closings has not been compiled but confirmed that some cities will lose their offices.

At weather service headquarters in Silver Spring, Md., spokeswoman Cynthia Smith said the National Weather Service will present Congress a budget and modernization plan Feb. 17.

U.S. Commerce Department officials have already told congressional leaders "some lower-priority offices would be closed, and that some specialized reports, such as agricultural forecasts, would be dropped," she said. The Commerce Department is the weather service's parent agency.

Nuhn, spokesman for the National Weather Service Employees Organization, said the union obtained internal weather service documents that project closing more than half of 249 offices nationwide, including those in Charlotte, Asheville and Greensboro or Raleigh, or both.

Ron Kuhn, meteorologist in charge of the Charlotte office, said he has no word about the closings. The Charlotte office has a staff of eight and an annual budget of more than $300,000.

"I knew there was supposed to be an announcement in the not-too-distant future," Kuhn said, "but I

See CHARLOTTE Page 4B

Charlotte Weather Office Could Close

Continued From Page 1B

don't know the first thing about it. It's all tied in with the Gramm-Rudman act, money cutbacks and reorganization."

The Charlotte office issues forecasts and severe-weather warnings for 11 N.C. counties, with a population of 1.3 million, and serves as backup for a much wider area.

recorded telephone forecasts, and about 60 public inquiries are handled directly.

The office broadcasts on a 24-hour weather radio channel, provides aviation weather for Charlotte/Douglas International Airport and monitors radar scans for a 250-mile area.

Smith said the plan headed to Congress this month is intended to pare costs and bring the weather service up to date.

The key is NEXRAD, the Next Generation Radar System.

In June, weather service officials said five Carolinas cities probably would be among the areas nationwide to get the new $450 million system by 1995. NEXRAD includes supercomputer

pinpoint possible tornadoes before they touch down.

They said installations would likely be in Raleigh-Durham, Wilmington and Morehead City in North Carolina and Columbia and Charleston in South Carolina.

The fate of Charlotte's office was left unclear. Authorities said the area probably would be covered by overlap from Columbia and other areas.

Tuesday, the forecaster union's Nuhn said the plan about to go to Congress calls for accelerating NEXRAD to 1990 or 1991.

Weather service officials said no offices would be closed until then, at least.

In Cary, near Raleigh, forecaster Herbert White said NEXRAD would still leave some of the [illegible] by local forecasters. White is state representative of the weather service union.

White said local offices work closely with local emergency management officials, aviators and others, and provide observations such as wind speed, temperatures, cloud conditions and visibility reports that can't be done with remote sensors.

Weather Service Will Close Offices In 6 Carolinas Cities

By ED MARTIN
Staff Writer

National Weather Service offices in six Carolinas cities will close as part of a modernization of the nation's weather forecasting system, officials said Thursday.

Confirmation of the closings ended months of uncertainty about which offices would close but left unclear exactly when in the six-year modernization program the offices will shut their doors.

"The Carolinas are more likely to be on the far end of the period," Don Witten of the National Oceanic and Atmospheric Administration said in Silver Spring, Md. The program is beginning in the Midwest and will probably ripple outward, he said.

Offices in Charlotte, Asheville, Greensboro and Cape Hatteras in North Carolina and Greenville-Spartanburg and Clemson in South Carolina will close, said Witten.

But other Carolinas offices will be strengthened. — Raleigh-Durham, Morehead City and Wilmington

See WEATHER Page 9C

Weather Offices Closing In 6 Carolinas Cities

Continued From Page 1C

in North Carolina, and Columbia and Charleston in South Carolina, will be upgraded to forecast centers, staffed with up to 25 meteorologists and equipped with sophisticated Next Generation Weather Radar — "Nexrad."

They will tie into a national network of Doppler radars, which can see into developing storms, and about 1,000 automated surface observation units.

The entire system will be linked to improved weather satellites and super-speed computers.

The result will be a pared system of 115 offices, compared with about 250 now, Witten said. That will allow the Weather Service to concentrate its staff members and equipment.

Witten said NOAA hopes to improve routine and severe weather forecasting, pinpointing winter storms more accurately and providing as much as 30 minutes of warning for tornadoes.

Although they will lose weather offices, cities like Charlotte will be covered by overlap from other Carolinas forecast centers and similar ones in Georgia, Tennessee and Virginia, Witten said.

At Charlotte/Douglas International Airport, automated observation devices will feed information on cloud cover, wind and other conditions to other centers.

"Just because you can't look out your window and see the weather office doesn't mean you don't have local coverage," he said.

Some forecasters will be transferred, and others will probably retire, Witten said.

The Charlotte office, which issues forecasts and weather warnings for 11 counties, has eight staff members. Others being closed have similar staffings.

Witten said the new system will be tested first in Nebraska, Kansas and Oklahoma — part of an area called "Tornado Alley."

"We'll run the new system parallel with the existing system to make comparisons," he said. "We have to be able to certify to the Congress that the new system is capable of doing it better."

Ms. PATTERSON. Thank you very much.

Next we will hear from Shirley Hill who is head of the Emergency Preparedness Office for Spartanburg.

Ms. HILL. First of all, Congresswoman Patterson, I want to take this opportunity to thank you for bringing this meeting to Spartanburg.

Members of the committee—and I am going to just read my prepared statement which takes about six minutes:

On behalf of Spartanburg County I appreciate this opportunity to testify on the proposed closing of the Greer Weather Service office. My testimony is intended to oppose the closing of the National Weather Service office in Greer, South Carolina.

And I would like to say here just like some of the other people that have testified, I agree with the modernization plan—I had a chance to read it for the first time last week—with the exception of closing the Greer Weather Service.

Natural disasters can strike any community and can cause injury, death and stress to individuals, families, institutions and businesses. Resources and programs to prevent or mitigate this requires coordination and cooperation from all levels of government—local, state and federal. This can only be achieved through the continued partnership of federal, state and local government, with the grass roots being at the local level.

Since January of 1989 the residents of Spartanburg County have been placed under the following weather conditions, and I think you will find this quite interesting for those of you who do not know this at this point:

We have been under one winter storm advisory, six severe thunderstorm watches, eight severe thunderstorm warnings, eleven flash flood watches, four flash flood warnings, four tornado watches and three tornado warnings.

On April 4, 1989 Spartanburg County experienced a tornado touchdown at the expense of $80,000 in real property. By the grace of God and early warning there were no fatalities or injuries.

On May the 5th, 1989 Spartanburg County experienced another tornado touchdown. We were not as fortunate this time. There were two fatalities, 35 injured and real property damage assessed at $2,009,100. History proves early warning saves lives. I firmly believe the early warning provided by the Greer Weather Service office personnel, the training of weather spotters, and the ongoing tornado awareness program in South Carolina saved lives on April the 4th and May the 5th.

It is my understanding the full-scale modernization plan for the National Weather Service proposes to close 125 weather offices of the existing 250. In this vicinity of the Southeast, the plan proposes to not only close the Greer office, but also the Asheville, North Carolina office and the Charlotte, North Carolina office. With the closing of these three offices, the Columbia weather office would be covering 21 additional counties. Ten of these counties are in the upstate of South Carolina with a population of approximately one and one-half million people. This is in addition to four counties from the Asheville office and seven counties from the Charlotte office.

Even with the high tech equipment, it is my opinion the service provided could not be as efficient as the service we receive at the present time from the Greer Weather Service staff.

The automated observation equipment being proposed could never replace the proficient, personal working relationship between the Greer staff and the emergency preparedness directors in the upstate that now exist. Mr. Wayne Jones, office in charge, and his staff are to be commended on providing this excellent service.

Not only is Spartanburg County vulnerable to natural disasters, our greatest vulnerability is hazardous materials accidents. This is attributed to several factors: the two interstate highways, two major railways, and some 28 chemical plants within the county. We also rely on the Greer Weather Service to provide emergency response personnel with prevailing wind information. This information is very important in making decisions when evacuating and sheltering people due to a hazardous material incident.

At this time the Greer Weather Service, as you are well aware of by this time, receives their radar from Athens, Georgia. With the population this office covers and with two of the counties, Greenville and Spartanburg, being two of the largest in South Carolina, there is a definite need for Dopler radar equipment at the Greer office. Once again I remind you, early warning saves lives.

In closing, as the Emergency Preparedness Director, and on behalf of the residents of Spartanburg County I appeal to you to reconsider the closing of the Greer Weather Service and let us keep one of our most vital resources for the protection of life and property.

Thank you very much.

[The prepared statement of Ms. Hill follows:]

TESTIMONY OF

SHIRLEY HILL, DIRECTOR OF THE
SPARTANBURG COUNTY EMERGENCY PREPAREDNESS DEPARTMENT

BEFORE THE

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

AUGUST 7, 1989

My name is Shirley Hill, and I am the Director for the Spartanburg County Emergency Preparedness Department. Mr. Chairman and members of the Committee, on behalf of Spartanburg County I appreciate this opportunity to testify on the proposed closing of the Greer Weather Service Office. My testimony is intended to oppose the closing of the National Weather Service office in Greer, South Carolina.

Natural disasters can strike any community and can cause injury, death, and stress to individuals, families, institutions, and businesses. Resources and programs to prevent or mitigate this requires coordination and cooperation from all levels of government - local, state, and federal. This can only be achieved through the continued partnership of federal, state, and local government; with the "Grass Roots" being at the local level.

Since January, 1989, the residents of Spartanburg County have been placed under the following weather conditions: one winter storm advisory, six severe thunderstorm watches, eight severe thunderstorm warnings, eleven flash flood watches, four flash flood warnings, four tornado watches, and three tornado warnings. On April 4, 1989, Spartanburg County experienced a tornado touchdown at the expense of $80,000.00 in real property. By the Grace of God and early warning, there were no fatalities or injuries. On May 5, 1989, Spartanburg County experienced another tornado touchdown. We were not as fortunate this time; there were two fatalities, thirty-five injuries, and real property damage assessed at $2,009,100.00. History proves early warning saves lives. I firmly believe the early warning provided by the Greer Weather Service office personnel, the training of weather spotters, and the on-going Tornado Awareness Program in South Carolina saved lives on April 4 and May 5.

It is my understanding the full-scale modernization plan for the National Weather Service proposes to close one hundred twenty-five weather offices of the existing two hundred fifty. In this vicinity of the Southeast, the plan proposes to not only close the Greer Weather office, but also the Asheville, North Carolina, Weather Office, and the Charlotte, North Carolina, Weather Office. With the closing of these three offices the Columbia Weather Office will be covering twenty-one additional counties. Ten of these counties are in the upstate of South Carolina, with a population of approximately one and one-half million people. This is in addition to four counties from the Asheville office and seven counties from the Charlotte office. Even with the high-tech equipment, it is my opinion the services provided could not be as efficient as the service we receive at the present time from the Greer Weather Service staff. The automated observation equipment being proposed could never replace the proficient, personal working relationship between the Greer staff and the Emergency Preparedness directors in the upstate that now exist. Mr. Wayne Jones, officer-in-charge, and his staff are to be commended on providing this excellent service.

Not only is Spartanburg County vulnerable to natural disasters, our greatest vulnerability is hazardous materials accidents. This is attributed to several factors: two interstate highways, two major railways, and some twenty-eight chemical plants within the county. We also rely on the Greer Weather Service to provide emergency response personnel with prevailing wind information. This information is very important in making decisions when evacuating and sheltering people due to a hazardous materials incident.

At this time the Greer Weather Service receives radar from Athens, Georgia. With the population this office covers and with two of the counties - Greenville and Spartanburg - being two of the largest in South Carolina, there is a definite need for Dopler Radar equipment at the Greer office. Once again, I remind you, early warning saves lives.

In closing, as the Emergency Preparedness Director and on behalf of the residents of Spartanburg County, I appeal to you to reconsider the closing of the Greer Weather Service office and let us keep one of our most vital resources for the protection of life and property.

Thank you.

Ms. PATTERSON. Thank you, Shirley.

We will now hear from Mike Phillips who is also the Director of Emergency Preparedness for Greenville County.

Mike.

Mr. PHILLIPS. OK. Three comments before I start on the prepared statement.

First, the Southeastern United States is a growing population area.

Next, the NEXRAD—picture this, Knoxville, Atlanta, Columbia, Raleigh and Roanoke—no other radar, and in the desperate center of all that upstate South Carolina.

The comment was made Mr. Jones did an excellent job, but Mr. Jones will not be there in a couple of years.

The National Weather Service Office in Greer, South Carolina is responsible for a population of approximately one million people. Some 300,000 of these people are from Greenville County. The citizens and the government of Greenville County are concerned about the impact of closing the Greer office of the National Weather Service. Not only do I believe that it will affect the response to a weather emergency, but I believe it will affect the planning, training, exercising and preparedness of Greenville and the other upstate counties.

I have taken several statements from reports issued by the weather service office in Greer. They are provided in writing, but will not be read in the verbal part of this statement. These statements are included to show several elements special to the National Weather Service office in Greer.

The close personal contact maintained between the local NWS office and the local government officials;

The training provided by the local NWS office to local spotters, citizens and emergency responders.

The real concern to provide accurate and fast information to the public, information which in these major events could affect the lives of hundreds of people.

The ability to provide good warning to a reasonably sized area, ten counties, and the inability of National Weather Service to provide warning on a larger scale.

The constant need for updating information on spotter networks, SLED teletype, NAWAS phones, National Weather Radio, local government radio, phone calls to the public officials, et cetera, and the manpower required to for that when similar events are affecting other NWS offices simultaneously.

During major weather events, the Greenville Office of Emergency Preparedness maintains constant monitoring of the National Weather Radio, NAWAS and the LGR, and is contact with the National Weather Service Office in Greer at least a dozen times during such a weather event, passing and receiving data on weather potential or damage reports.

We have developed a close working relationship with the Greer office. This includes cooperation, trust and dependency. I do not believe that such a relationship could be established with another office placed far away. The trust will invalidate itself when such a distant office fails to provide adequate warning due to lack of staff, lack of local familiarity, and lack of up-to-date data from the vari-

ous affected areas. The dependency on each other will certainly fall off to nothing since local TV meteorologists may have a better handle on the local situation than a distant National Weather Service office, and local EBS will be activated by local authorities, all this resulting in shorter or nonexistent lead times, possibly more deaths and injuries, and the failing of a system which to this point has certainly saved lives in the upstate of South Carolina.

For years I have stressed two key points in disaster preparedness:

No. 1, that severe thunderstorms can do as much damage as a tornado because of high winds, downbursts and heavy rains;

No. 2, that if there is a disaster it will be a multiple disaster such as storm damage, multiple victims, electrical outage, communications loss, et cetera.

It is because of better cooperation, better training and and better information that we can deal with the first in order to avoid or limit the second.

The National Weather Service Greer office is providing that quality program. Examples of these services are face-to-face discussions, familiarity with the special upstate needs such as floodplain and the effect of the mountain range on our weather. Other circumstances are special upstate event times such as Freedom Week End Aloft, Fall for Greenville, and even "bag days," and how it is even more vital to have up-to-date information, lead times and adequate warning for these events. A distant office would not understand the impact of Freedom Week End Aloft. The National Weather Service Greer office has been very cooperative not only in obtaining NOAA training and information publications, but also in seeking out and providing materials published in other localities which are of special interest to upstate residents, such as heat wave brochures and tornado and water conservation information. A distant National Weather Service office would likely not be as interested in the upstate, and not have adequate staff under the new proposal to provide these services, nor to train spotters, nor to help in local floodplain management.

In a real weather emergency, a distant office handling a larger volume of traffic would be more likely to miss listing a county on the warning for the National Weather Radio, or mix up the warnings for events happening simultaneously all over the state, or not see a major event starting to happen in one area because they are concentrating on an event in progress in another area.

I also have some concerns with NEXRAD's capabilities, although better than present radar, they may be overly praised when providing coverage for the mountains in the upstate as well as some portions of the rest of the state. I do not believe that a distant National Weather Service office can provide timely warning to the public, alert local officials and receive good spotter information as well as the local National Weather Service office in Greer can do and has done for the upstate.

Our past experience with National Weather Service Greer has been exceptional, and has even improved lately because of the concern and interest of the local officer in charge, Wayne Jones. During the April 4th and May 5th storms, we had notice calls hours before the actual storms, which allowed us the lead time to

notify government officials, emergency personnel, volunteers and special needs groups. I believe that this cooperation locally has already helped to save lives, and provide faster, more efficient recovery. I personally believe it would be a grave mistake to move the National Weather Service office from Greer, South Carolina to some more distant point.

There is a game in the stores where blocks are stacked up and removed one at a time. Eventually, and without a doubt, the support strength will fail and all the blocks will come down. National Weather Service Greer is only one of those blocks, but it is certainly a key one in the next weather disaster in the upstate. What will happen if it is not there?

Thank you.

[The prepared statement of Mr. Phillips follows:]

County of Greenville

OFFICE OF EMERGENCY PREPAREDNESS
Michael B. Phillips
Coordinator

Prepared Statement for the Sub-Committee on Natural Resources, Agricultural Research, and Environment.

The National Weather Service office in Greer, S.C., is responsible for a population of approximately one million people. Some 300,000 of these people are from Greenville County. The citizens and the Government of Greenville County are concerned about the impact of closing the Greer office, NWS. Not only do I believe that it will affect the response to weather emergencies, but I believe it will affect the Planning, Training, Exercising, and Preparedness of Greenville and the other upstate counties.

I have taken several statements from reports issued by WSO, Greer, SC. They are provided in writing, but will not be read in the verbal part of this statement. These statements are included to show several elements special to the NWS office in Greer.

A. The close personal contact maintained between the local NWS office and local government officials.
B. The training provided by the local NWS office to local spotters, citizens, and emergency responders.
C. The real concern to provide accurate and fast information to the public, information which in these major events, could affect the lives of hundreds of people.
D. The ability to provide good warning to a reasonably sized area, 10 counties, and the inability of NWS to provide warning on a larger scale.
E. The constant need for updating information on Spotter networks, SLED teletype, NAWASphones, National Weather Radio, Local Government Radio, phone calls to public officials, etc., and the manpower required for that when similar events are affecting other NWS offices simultaneously.

During major weather events, the Greenville Office of Emergency Preparedness maintains constant monitoring of the National Weather Radio, NAWAS, and the LGR, and is in contact with NWS-Greer at least a dozen times during such a weather event, passing and receiving data on weather potential or damage reports. We have developed a close working relationship with NWS-Greer. This includes cooperation, trust, and dependency. I do not believe that such a relationship could be established with another office placed far away. The trust will invalidate itself when such a distant office fails to provide adequate warning due to lack of staff, lack of local familiarity, and lack of up-to-date data from the various affected areas. The dependency on each other will certainly fall off to nothing since local TV meteorologists may have a better handle on the local situation than a distant NWS office, and local EBS will be activated by local authorities; all this resulting in shorter or non-existent lead times, possibly more deaths and injuries, and the failing of a system which to this point has certainly saved lives in the upstate of South Carolina.

206 S. MAIN STREET
MAILING ADDRESS
P.O. BOX 2207
GREENVILLE, SOUTH CAROLINA 29602
(803) 242-2680

For years I have stressed two key points in disaster preparedness: 1. That severe thunderstorms can do as much damage as a tornado because of high winds, downbursts, and heavy rains; and, 2. That if there is a disaster, it will be a multiple disaster, such as storm damage, multiple victims, electrical outage, communications loss, etc. It is because of better cooperation, better training, and better information, that we can deal with the first in order to avoid or limit the second. The NWS-Greer office is providing that quality program. Examples of these services are face-to-face discussions, familiarity with special upstate needs such as floodplain management and the effect of the mountain range on our weather. Other circumstances are special upstate event times such as Freedom Weekend Aloft, Fall for Greenville, and even "bag days"; and how it is even more vital to have up-to-date information, lead times, and adequate warnings for these events. A distant office would not understand the impact of Freedom Weekend Aloft. The NWS-Greer office has been very cooperative, not only in obtaining NOAA training and information publications, but also in seeking out and providing materials published in other localities which are of special interest to upstate residents, such as heat wave brochures, and tornado and water conservation information. A distant NWS office would likely not be as interested in the upstate, and not have adequate staff under the new proposal to provide these services, nor to train spotters, nor to help in local floodplain management.

In a real weather emergency, a distant office handling a larger volume of traffic, would be more likely to miss listing a county on the warning for the National Weather Radio, or mix up the warnings for events happening simultaneously all over the state, or not see a major event starting to happen in one area because they are concentrating on an event in progress in another area.

I also have some concerns that Nexrad's capabilities, although better than present Radar, may be overly praised when providing coverage for the mountains in the upstate as well as some portions of the rest of the state. I do not believe that a distant NWS office can provide timely warning to the public, alert local officials, and receive good spotter information, as well as the local NWS-Greer office can do, and has done, for the upstate.

Our past experience with NWS-Greer has been exceptional, and has even improved lately because of the concern and interest of the local Officer-in-Charge Wayne Jones. During the April 4th and May 5th storms, we had notice calls hours before the actual storms, which allowed us the lead time to notify government officials, emergency personnel, volunteers, and special needs groups. I believe that this cooperation locally has already helped to save lives, and provide faster, more efficient recovery, I personally believe it would be a grave mistake to move the NWS office from Greer, SC, to some more distant point.

There is a game in the stores where blocks are stacked up, and removed one at a time. Eventually, and without a doubt, the support strength will fail, and all the blocks will come down. NWS-Greer is only one of those blocks, but it is certainly a key one in the next weather disaster in the upstate. What will happen if it is not there?

Greenville County, S.C.
Office of Emergency Preparedness

Quotes from January 1989 NWS-Greer Newsletter:

1. ...most of the severe weather in the southeastern U.S. is in the form of winds from thunderstorms, and hail. We do have tornadoes, but they're normally small and short lived. The large, powerful severe thunderstorms are frequently just as damaging to a community as a small tornado.
2. (Speaking of Spotter reports) Your report...might be the piece of the puzzle National Weather Service forecasters are looking for...which might prompt school officials to cancel classes, which might get busses off the road in time to prevent disaster.

Quotes from April 10, 1989 report of April 4 storms:

1. Our dedicated Kavouras imagery from WSO AHN had become almost useless during the period in which their CWA (County Warning Area) was being affected. It remained that way during most of the time the activity was in our area.
2. (Speaking of NWS-Greer) There is no reason a NWS office should have to operate in such a crippled condition.
3. However, this was probably the most significant event in our area in the past 15 years...
4. Upstate South Carolina contains some of the most densely populated counties in the southeast U.S. ...
5. Had the storm track been just a mile or two farther north - damage would have been much worse. As it was, the downburst winds and gust front winds which occurred caused as much damage as the tornadoes.
6. During the storm survey, many people said they heard the warnings, understood the threat, and took action...This indicates not only the impact of the warnings, but the successof the past preparedness work from both the local office and on the management area level.
7. NOAA Weather Radio functioned flawlessly during the episode. Some of the local retailers reported a "run" on the units following the storms... At one point during the episode there were four separate warning tapes in the cycle.
8. The dedicated line (RADAR) to AHN is not adequate - 20 minute intervals during an outbreak is simply too much...Good warnings were issued in spite of the RADAR imagery - not because of it.
9. The warning system of the National Weather Service worked quite well primarily because of preparation in the hours before the storms hit. The counties were aware of the coming severe weather because of that preparation...there are clear indications that our actions saved lives.
10. Of prime importance was the teamwork between a local NWS office, local government agencies, and the media.
11. There is some danger that both the public and local government officials will mistake this episode for "the big one".

Greenville County, S.C.
Office of Emergency Preparedness

Quotes from May 15, 1989 report of May 5 storms:

1. WSPA Radio understood, but WFBC did not have anyone familiar with local EBS (Emergency Broadcast Stations) procedures on duty. As a result, warnings which affected their operational area were not broadcast over EBS.
2. We decided that 3 person coverage was required again for this episode and held the day shift over. Because of the obvious urgency of the developing situation, calls were made to county Emergency Preparedness offices...
3. As on April 4, RADAR imagery became a problem. During the period the activity was affecting WSO AHN's County Warning Area and afterward - updates were only available to our office at 20 to 30 minute intervals. On May 5 this directly resulted in negative lead time warnings...
4. It was now becoming clear to us that something was going ahead of the line - but Radar imagery was so poor that we were unable to get a handle on the situation.
5. A very bright and large echo was moving directly toward the city of Laurens, and we felt we could take no chances in such a volatile situation.
6. However, there were several areas of downburst which produced concentrated wind damage...very intense rainfall...which caused some brief localized flooding...
7. We have been very busy training spotters in our 10 counties this year. That must always be a priority within the NWS. Spotter training combined with well designed preparedness work in the local community will continue to save lives. Along the same lines, close personal contact with local government officials permits a more efficient methodology during emergency situations.
8. ...something important to note is the fact that 3 people were completely swamped with work maintaining adequate warning for 10 counties...We also had an amateur radio operator in the office - just as busy as we were.

Ms. PATTERSON. Thank you very much, Mr. Phillips.

Next we will hear from Mr. Jimmy Wilkins who is the Director of Emergency Preparedness in Union. Jimmy.

Mr. WILKINS. Thank you, ma'am.

I hate to follow these two people here just ahead of me, but I will do my best.

Ms. PATTERSON. You will do fine.

Mr. WILKINS. The Greer Weather Service provides a very important and valuable service to Union County. We rely on it for long-range as well as the immediate weather bulletins for emergency planning and response to weather emergencies such as tornadoes, thunderstorms, severe thunderstorms, winter storms, flash flood watches and warnings.

That is just a portion of my written statement. I would like to make another comment. According to Dr. Friday we do not have anything to worry about about closing the Greer Weather Service down. I would just like to say if our elected officials in Washington allow this weather station to be closed then, Ms. Patterson, I feel like they are not serving the best interest of their public.

[The prepared statement of Mr. Wilkins follows:]

Union County
Emergency Preparedness Agency

P.O. DRAWER R
UNION, SOUTH CAROLINA 29379
TELEPHONE 427-9720

STATEMENT OF
JIMMY WILKINS, DIRECTOR
EMERGENCY PREPAREDNESS AGENCY
UNION COUNTY, SOUTH CAROLINA

BEFORE THE
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT

AUGUST 7, 1989

The Greer Weather Service Office provides a very important and valuable service to Union County. We rely on long range, as well as, the immediate weather bulletins for all emergency planning and response to weather emergencies such as; tornadoes, severe thunderstorms, winter storms and flash flood watch and warnings. Having first-hand information on wind directions and local conditions in the event of a Hazardous Materials spill, or release, is very important to the citizens of Union County and this office.

Also, we rely on the Greer Weather Service for all information to notify the schools, businesses, and the public of threatening weather conditions.

We have a personal contact with the weather service personnel before, and after, there is a possible threatening weather condition. At this time, we can report to them the local conditions, and the results of the weather emergency.

Natural or man-made disasters may strike Union County at anytime, and I strongly support keeping the Greer Weather Station open.

Thank you.

Ms. PATTERSON. Thank you, Jimmy.

Let me say to you since you are from Union, I was in Union County when the first warnings came out about the tornado. As a matter of fact, I was with one of our local media people, and they said "Whoops, we have got to leave you because there are tornadoes spotted in Pickins County," and they left me in Union and went to Pickins to cover the tornadoes that were hitting in Spartanburg County, so Union very much plays a part in this.

We call on at this time one of our neighbors from the north, Wayne Broome, who is the Director of the Charlotte-Mecklenburg Emergency Management Office.

Mr. BROOME. Thank you, Ms. Patterson.

Before I get started, I would like to say thank you to the people of South Carolina for extending this invitation. It is a pleasure to be here.

I have prepared a statement, I think that you might have that before you, and I am just going to read the statement to you, and then I will be glad to respond to any questions that you might have.

As the Director of the Charlotte-Mecklenburg Emergency Management Office, I feel strongly about the proposed changes that are scheduled to take place in the local office. With the recent adverse weather events that have taken place in and around my community, both accurate and timely weather information has taken on a new meaning and a new importance.

The Charlotte-Mecklenburg community represents an economic and cultural hub for an area that extends over 50 miles or more. The quality of life we enjoy in our community was accomplished by hard work and good planning that included dealing with the possibility of disasters or emergencies that could occur in our community. The development of the disaster plans, the extensive training and the numerous drills and exercises that we have had included the National Weather Service office. Today I feel my community is at the forefront in the emergency management field. I also feel that the weather service has made a significant contribution in this effort.

Our community has made the National Weather Service office an essential part of our overall emergency response program. The weather office is a critical link in activating the Emergency Broadcast System for all severe weather conditions, and for other weather-related events. In addition, the weather office participates in EBS activation for other disasters or emergencies to warn people that are tuned in to NOAA weather radio. The work by my office, the local weather office, the media and our community leaders has created an environment of a "we" community in Charlotte-Mecklenburg, and not a community of "them or us."

The latest report from the North Carolina Department of Human Resources discloses that Charlotte-Mecklenburg generated over 1.6 billion pounds of hazardous waste. In addition, based on the amount of waste that was shipped out of the state, 175.7 million pounds, most of it, 126.6 million pounds, traveled through our community. If an accident occurs that involves this type of material, weather information would be critical in order to determine the plume exposure pathway of any toxic or harmful cloud.

Our community is also bordered by two nuclear power stations with a total of four nuclear reactors. No other community in the nation is confronted with this potential threat. If an accident occurs at one of these facilities, weather information becomes very important. Our leaders need to know wind speed, wind direction and other necessary information in order to make timely and accurate decisions on evacuation and sheltering of the population.

To date, our community has had over 300 companies to report to us under the Superfund Amendment and Reauthorization Act, title III of 1986, commonly referred to as the SARA Title III program. This additional threat has increased our need to have timely and accurate weather information. In many fires involving hazardous materials you cannot use water to put them out, as the firemen in this audience can attest to, the fire simply has to burn itself out. If this type of incident were to occur, our emergency response personnel and community leaders would need a continuous dialogue with the weather office.

If modernization is to occur in the weather office, and I think that it should, I feel the communities that would benefit the most would be those that represent the greatest chance of death or injury by weather-related events. The Charlotte-Mecklenburg community is the largest community in the Carolinas. The potential for death or injury is a constant concern for our elected officials and citizens. The local office of the National Weather Office offers some degree of comfort to our leaders in that they provide us with a much needed service in a very timely and professional manner. This factor has contributed greatly to the high degree of preparedness in our community.

In summary, I feel that local governments were left out of a most important change in a program where the direct impact of this change is at the local government level. I feel there are many questions that have not been asked, such as questions about how NOAA weather radio will be activated, how the EBS will be activated when crossing state lines are involved, about gaps on coverage, about not getting weather information below 10,000 feet when the forecast office is located 70 to 80 miles away. These are just a few of the questions that need to be asked. I am sure there are many others.

I also feel that there are some federal agencies that should have input on the proposed changes. Agencies such as the Federal Emergency Management Agency and the Federal Communications Commission are two that come to mind immediately.

Finally, no other weather office in the Carolinas serves as many people, over 1.4 million, as the local office of the National Weather Service. If you want to modernize where it will do the most good for the most people, why not begin with the Charlotte office?

Thank you.

[The prepared statement of Mr. Broome follows:]

hairman Roe, members of the committee, and distinguished guests. It is ndeed a pleasure to appear before you today and to testify on the proposed hanges that are scheduled to take place in the National Weather Service (NWS).

s director of the Charlotte-Mecklenburg Emergency Management Office, I feel trongly about the proposed changes that are scheduled to take place in the ocal office. With the recent adverse weather events that have taken place in nd around my community, both accurate and timely weather information has aken on new meaning, and a new importance.

he Charlotte-Mecklenburg community represents an economic and cultural hub or an area that extends over 50 miles or more. The quality of life we enjoy n our community was accomplished by hard work and good planning that included ealing with the possibility of disasters or emergencies that could occur in ur community. The development of disaster plans, extensive training, and merous drills and exercises included the National Weather Service Office. oday I feel my community is at the forefront in the emergency management ield. I also feel that the weather service has made a significant contribu- ion in this effort.

ur community has made the National Weather Service Office an essential part our overall emergency response program. The weather office is a critical ink in activating the Emergency Broadcast System (EBS) for all severe weather onditions, and for other weather related events. In addition, the weather ffice participates in EBS activation for other disasters or emergencies to arn people that are tuned to the NOAA weather radio. The work by my office,

the local weather office, the media, and our community leaders has created an environment of a WE community, and not a THEM or US community.

The latest report from the North Carolina Department of Human Resources discloses that Charlotte-Mecklenburg generated over 1.6 billion pounds of hazardous waste. In addition, based on the amount of waste that was shipped out of the state, 175.7 million pounds, most of it (over 126.6 million pounds) traveled through our community. If an accident occurs that involves this type of material, weather information would be critical in order to determine the plume exposure pathway of any toxic or harmful cloud.

Our community is also bordered by two nuclear power stations, with a total of four reactors. No other community in the nation is confronted with this potential threat. If an accident occurs at one of these facilities, weather information becomes very important. Our leaders need to know wind speed, wind direction, and other necessary information in order to make timely and accurate decisions on evacuation and sheltering of the population.

To date, our community has had over 300 companies to report under the Superfund Amendment and Reauthorization Act Title III of 1986, commonly referred to as the SARA Title III program. This act deals with the hazardous materials that are present in a community. This additional threat has increased our need to have timely and accurate weather information. In many fires involving hazardous materials water cannot be used, the fire simply has to burn itself out. If this type of incident were to occur, our emergency response personnel and community leaders would need to have continuous dialogue with the weather office.

If modernization is to occur in the weather service, and I think it should, I feel the communities that would benefit the most would be those that represent the greatest chance for death or injury by weather related events. The Charlotte-Mecklenburg community is the largest community in the Carolinas. The potential for death or injury is a constant concern for our elected officials and citizens. The local office of the NWS offers some degree of comfort to our leaders in that they provide us with a much needed service in a timely and professional manner. This factor has contributed greatly to the high degree of preparedness in our community.

In summary, I feel that local governments were left out of a most important change in a program where the direct impact of the change is felt at the local government level. I feel there are many questions that have not been asked such as questions about how NOAA weather radio will activated, how the EBS will be activated when crossing state lines is involved, about gaps in coverage, and about not getting weather information below 10,000 feet when the forecast office is located 70 to 80 miles away. These are just a few of the questions that need to be asked; I am sure there are many others. I also feel that some federal agencies should have input on the proposed changes. Agencies such as FEMA and the FCC are two that immediately come to mind. Finally, no other weather office in the Carolinas serves as many people (over 1.4 million) as the local office of the National Weather Service. If you want to modernize where it will do the most good for the most people, why not begin with the Charlotte office?

Thank you.

IREDELL COUNTY
Post Office Box 788
Statesville, North Carolina 28677

Emergency Management

(704) 878-3039

August 3, 1989

Congressman Alex McMillan
401 W. Trade Street, Suite 222
Charlotte, North Carolina 28202

Dear Sir,

I am very disheartened to learn of the proposed closing of the Charlotte Office of the National Weather Service. I also understand that the Committee on Science, Research and Technology is holding a public hearing on this matter Monday, August 7, 1989 in South Carolina. While I cannot attend this most important meeting I would like to inform you of my feelings in this matter.

In early May of this year Iredell County (along with many others in North Carolina) experienced the most severe weather conditions in recent history. Tornadoes, high winds, dangerous lightning and heavy rain caused over three million dollars in damages within two days. Only two persons died in Iredell County as a result. I attribute this to many factors but one factor is the early warning and constant updated information we received from the Charlotte Office of the National Weather Service. Emergency Management, as well as emergency services field personnel were able to respond much more effectively because of the information supplied by NWS.

With the close working relationship between the NWS and local Emergency Management we can help save lives with early warning. There is no other way for us to receive this warning in such an accurate manner than through the NWS.

Iredell County is not in the Charlotte "district" even though we have made the request. The weather systems that effect Iredell county most often come from the southwest and west. We get the early warning from Charlotte, as well as our neighboring counties. The Charlotte Office of the National Weather Service is vital to the operations of Emergency Management in Iredell County.

I would request you or your office to address my concerns to the committee. I would urge the Committee to keep the Charlotte Office of the National Weather Service open and functional. In addition, I would urge that this office be upgraded to the most state of the art equipment available.

Sincerely,

Wm. L. Dickerson - Coordinator
Iredell County Emergency Management

cc: Mr. Wayne Broome - Mecklenburg County EMC
Mr. Joel Mashburn, Iredell County Manager
Mr. Jack Hughes - Area "E" Coordinator

CHARLOTTE

July 24, 1989

The Honorable J. Alex McMillan
U.S. Representative, 9th Congressional District
507 Cannon House Office Building
Washington, D.C. 20515

Dear Representative McMillan:

This letter is written to express a very deep concern associated with the possible closing of the local office of the National Weather Service (NWS) in Charlotte, North Carolina. There have been several stories and articles in the local media as well as several meetings conducted that related to the possibility of closing the Charlotte office. At the present time all indications point to the office being closed as part of a modernization scheme of detection equipment used by the weather service, commonly referred to as NEXRAD, or next generation radar.

My concern associated with his proposed activity is very strong for several reasons. Local government had absolutely no input into this proposed change. I assume that since this action was initiated by the federal government, it was viewed as a "no concern situation" on the part of local or state government. The most important result of this mode of thought is that the impact of the proposed change is felt at the local and state levels, not the federal level. There are a great many questions that have NOT been asked about the new program. How will this change affect the NOAA weather radio? How will this change affect the activation of the Emergency Broadcast System (EBS) when such activations often require the crossing of state lines. This change will require major modifications in all planning documents for state and local governments, perhaps to the extent of re-setting all of the EBS operational areas in the United States. Will the elected officials of a community be able to talk person-to-person to a weather official under the new system? Will Emergency Management officials be able to get both timely and accurate weather information during a disaster or emergency situation? These are but a few questions that have NOT been asked about the new program. I am sure there a multitude of others.

Recent information, admitted to by the management team of the new program, has revealed that there are gaps in coverage. In addition, at certain distances there would be no weather information for weather conditions below 10,000 feet. This is something that I, as an Emergency Management official, find totally unacceptable. Our community is bordered by four nuclear reactors, two in the northern part of Mecklenburg County and two located just across the state line in South Carolina. It is imperative that we be able to

Charlotte-Mecklenburg Emergency Management Office
600 East Fourth Street Charlotte, NC 28202-2852 704/336-2412

get accurate weather information in order to make critical decisions associated with evacuation and sheltering of a significant portion of our population (45,00 to 90,000 people). In addition, over seventy-five percent of all the hazardous materials and/or hazardous waste generated in the state of North Carolina is shipped, stored, processed, warehoused, or reprocessed in the Charlotte-Mecklenburg community. In the event of a hazardous material accident or incident it is also important to have accurate weather information in order to determine plume exposure pathways. This information is critical if we are to provide for the safety and welfare of our citizens. I am not sure we can get an accurate portrayal of our weather conditions from a center located eighty to ninety miles away, and one which cannot monitor below 10,000 feet.

The local office of the National Weather Service serves an eleven county area with a population of 1.2 to 1.4 million people. Our community represents the largest city between Atlanta, Georgia and Washington, DC. We have one of the fastest growing communities in the Southeast, as well as one of the fastest growing airports in the nation. This fact, in addition to the strong economy we enjoy represents essential elements in our quality of life. Our people want, and are entitled, to feel safe and protected when it comes to disasters or emergencies. The weather service contributes to this effort in providing the services that they do.

This new system was presented to many people as the cure all for current conditions in the weather service. However, the more questions that we ask, the more we, as local officials, see the system as having major weaknesses.

I am fully aware of the very busy schedules and demands that are placed on you on a daily basis. However, I feel so strongly about this proposed action that I am asking you to interrupt your schedule and ask some questions. In order to provide you with a starting point, it might interest you to know that Representative Tim Valentine, (D-NC), is the chairman of the U.S. House Science subcommittee on Transportation, Aviation, and Materials, which is examining and evaluating the new system.

If I can provide you with additional information please do not hesitate to call or write me at the letterhead address and telephone number. I would be most thankful for any effort on your part in maintaining our local office of the National Weather Service. It truly is a needed asset to our community.

Sincerely yours,

L. Wayne Broome, Director
Charlotte-Mecklenburg Emergency Management Office

cc: U.S. Senator Jesse Helms
U.S. Representative Tim Valentine

Ms. PATTERSON. Thank you very much, Mr. Broome.

At this time if the panels do not mind, we need to take a few minutes' break—maybe you all will appreciate this—the media wants to do a live broadcast from the hearing a few minutes after twelve, so we will need to take a little break to accommodate the media. I hope you all will understand. If you all will remain where we can ask some questions of you immediately following, we will take about a ten-minute break at this time.

[A brief recess.]

Ms. PATTERSON. I am sorry for that break, but I think everyone here realizes how important it is that we let those who are not here today know what is going on and know how important our weather station is and the information that we have been able to gather, so that is what the little break was all about.

Before I start my questioning, let me just say to our panel how much we appreciate the Emergency Preparedness Office, not just when tornadoes come, but for other emergencies, and we know that you are on call 24 hours 365 days a year, and we appreciate you, and I am sure the people of the area have appreciated you all's efforts when a real emergency does occur.

Let me also say that I learned something today as we were talking or listening to you. I think I had the tornado and severe weather on my mind and did not realize how we needed the weather service in other emergencies such as hazardous waste spills, chemical spills, plants that might have emergencies, and we need to know about the winds as they affect those disasters, so I learned something, and again I appreciate all that you do in your area.

I would like to ask a few questions. I am sorry that our other members left, but they did have to get back to their districts. They left with me some questions, and I would like to sort of propose some of those to you if I might, and I will let whomever wishes—I will not select one—whomever wishes to answer this question.

Normally how do you first hear about impending or possible severe weather conditions coming? Does the weather service call you? Do you have a network set up? When do you first hear, and how do you first hear if your services might be needed?

Ms. HILL. I will start that.

Ms. PATTERSON. Okay. Please do speak into the mike so everybody can hear.

Ms. HILL. We have several different ways. We have a weather wire, we have the NAWAS line, we also have SLED teletype, but I think the most important thing is that in the past 18 months that Mr. Wayne Jones has been officer in charge over at the Greer Weather Service, and maybe he has spoiled us, but I think it is very important that he does what he does.

Wayne never hesitates to to get on the telephone to each of the emergency preparedness directors in the ten counties in the upstate. For example, on April the 4th probably at 10:30 that morning he was on the telephone with my office saying "It looks like we are going to be in for some very severe weather this afternoon," and we talked numerous times that day, and this was also true on May the 5th, and that was what I was talking about in my testimony, the personal working relationship that we have with the Greer

staff and the emergency preparedness directors in the upstate, and this is a very vital resource that we have.

Ms. PATTERSON. I noticed in Mr. Phillips' statement he also mentioned the close working relationship that you all have with the weather service and how they help.

Mr. Broome, did you want to——

Mr. BROOME. I just wanted to say in the planning process that we have developed in Charlotte-Mecklenburg I want my individual at the weather office to call me, whether it is the person in charge or whether it is a member of the staff, but our system is set up so that they call and activate the emergency broadcasting system first, especially for life-threatening situations so that the public becomes aware of it as quick as possible so that they can take action.

I want to be notified so that I can put my procedures and plans in place, but that is not the most critical service that they provide from that standpoint. The activation of the EBS is the most critical thing, and they can do that in an extremely timely manner because of the processes that we have set up.

Ms. PATTERSON. You all have both alluded to it, but are there some written arrangements that you have for the use of the emergency broadcast system during weather emergencies, and could the emergency broadcast system be made more useful to you in weather emergencies?

Mr. PHILLIPS. Can I touch on that one?

Ms. PATTERSON. Please.

Mr. PHILLIPS. Yes, the emergency broadcast system, it is a good system, but it is—it needs to be updated seriously. The state emergency preparedness office has looked at that over the past several years with not a great deal of success. If you notice in Mr. Jones' reports, there was a problem with one of the reports getting out in the Greenville area because they lacked the understanding of the EBS system, and that is the problem. It is something that needs to be updated a little bit, and remind people—particularly remind the people who are putting out the message, you know, what its function is, because it is useful in so many situations, the weather situations and many others, that sometimes it is like our agency, they do not look at us until something goes wrong, and then they look at us real hard.

And EBS is the same way, it is a thing that you put over on the shelf and do not pay attention to until the bad winter storm comes in, or the tornadoes are coming through Pickins County, and then Greenville looks at it very seriously, but it is too late then.

Mr. WILKINS. Could I say something on the communications?

Ms. PATTERSON. Yes, please.

Mr. WILKINS. We also have two-way radio communications with the Greer weather station, you know, in the event the phone was out and something happened that that was the only connection that we had with them, and they were talking about doing away, you know, unmanning it during the night. In the middle of the night if we had some kind of emergency and we needed to have radio communications with them, if it was unmanned we would not have any other way to talk to them.

Ms. HILL. This is done through our local government radio, through our state Emergency Preparedness Division, and I think

almost all 46 counties within the state have this capability with the local government radio, and Greer weather service also has this capability to where—and Jimmy brought out a good point, if the telephone lines were down we would still have communications with them by radio.

Mr. PHILLIPS. I would like to step back for one item. You asked about how we initially find out about these things, and I think this is significant, too.

I do not want to give you the impression that National Weather Service is the only contact we have, but they are primary, and even more so before the event happens, because we—it is like most of the people have alluded to, we look to Georgia and Alabama for our weather, so most of us review the weather every night when we go home, or at eleven o'clock or whatever to see what is coming across our area the next day, and Wayne and the other officers out there at National Weather Service have helped us in other things that we do, too, because we monitor the hurricanes from the Gulf Coast.

A lot of people do not realize that, they think hurricanes down there do not mean anything to Greenville, South Carolina, but they mean a great deal to Greenville, because that is where many of our tornadoes come from, it is out of those storms that have come on land bringing all that water up into our area, and then suddenly releasing it across the upstate area. We get tornadoes, we get flooding, we get a lot of things. We get major wind damage, you know, out of those left-over hurricanes so, you know, we have learned to watch those hurricanes because of the things that he has taught us, and the other people in National Weather Service have taught us to be mindful of those events as well, so we watch a lot of things long before they come into our area, but we get good response during the event because we get good warning notices from National Weather Service.

Ms. PATTERSON. But I did understand from you all that there is sort of a formal agreement about how they get in touch with you whenever there is a possibility of severe weather, there is sort of a—I see Mr. Broome——

Mr. BROOME. I know in Charlotte there is a formal process and a call list that is maintained by the weather weather office, and the numbers are updated annually as a minimum, so there is a written document in place.

Ms. PATTERSON. Do all three counties here in South Carolina have such——

Mr. BROOME. We all have alert lists to make contact. It is a question of who would be called, depending upon the situation, and I am sure National Weather Service has one, too.

Ms. PATTERSON. As I recall, during the storm in May several people out in the county told me that one reason they were not able to give notice was because the power was down, so in your case you do have like you say the radio that you can communicate with. I remember Shirley had hers.

Ms. HILL. The problem there is we were—Spartanburg County was under a tornado watch from what, about 2:30 that afternoon, Wayne?—and of course the residents of the county knew that we were under a watch, and the way it is—and I have questioned this

at times myself—when you go under a watch you do not sound he outdoor sirens, you wait until you go under a warning. The way it is now, and with the system that we have you do not go under a tornado warning until one has been spotted in your county. When one is spotted, just like what happened in Chesnee, it had been spotted and by the time the sirens were activated from the central communications center the power was already out there, and this is another thing that we will be looking at with purchasing new sirens and replacing them.

There is a new system out now with a battery operated backup, and so we are going to be looking at this in Spartanburg County.

Ms. PATTERSON. I think something that was pointed out earlier to me and, Mr. Broome, you pointed it out, weather does not stop at a county line or a state line, and I think that is one thing maybe we need to work with the weather service on that, you know, just a state line does not—well, as we proved, the tornadoes go right on across the line, so I think we have learned a great deal today. At least I have, and I appreciate your work in time of emergencies, but also your time serving the people in being here today.

Thank you very much.

Mr. BROOME. Thank you.

At this time we will move into our last panel which are the Radar and Aviation Weather Panel.

We appreciate you all's patience as we got down to this particular one.

Sit in any order.

[Pause.]

Ms. PATTERSON. At this time we will begin with—and you will have to correct me if I pronounce it wrong—Dr. Carlton Ulbrich.

Dr. ULBRICH. That is correct.

Ms. PATTERSON. We are glad to have you. He represents Clemson University Department of Physics.

STATEMENTS OF DR. CARLTON W. ULBRICH, DEPARTMENT OF PHYSICS, CLEMSON UNIVERSITY, CLEMSON, SC; CHRIS REDDICK, MANAGER, DELTA AIR LINES, GREENVILLE-SPARTANBURG AIRPORT, SC; AND LARRY HOLCOMB, AIRPORT OPERATIONS MANAGER, GREENVILLE-SPARTANBURG AIRPORT, SC

Dr. ULBRICH. Thank you.

I have already presented a prepared statement to the committee, and I will just summarize it very briefly in the interest of saving time, and supplement it with a couple of remarks if I might.

I am a professor of physics at Clemson University, and I have been involved in atmospheric physics teaching and research for more than 20 years. My research has employed radar in a variety of experimental research projects, and I have listed them in the prepared statement.

The instrument is a fairly new one, it is only about 30 or 40 years old, and has only recently been used in an operational way to observe the weather.

We have great confidence in our ability to measure many things with radar, and I will not attempt to list them all, only to say that we have confidence in the ability of the radar to measure circula-

tion patterns and storms aloft before tornadoes arrive at the ground.

In fact, in the research projects that Dr. Friday has referred to in Oklahoma the radar is a single Dopler radar that has been used to measure circulation patterns aloft in storms, and in over 90 percent of the cases the circulation patterns have been positively identified with tornadoes at the ground after having been detected aloft.

In the remaining cases the researchers claim that it was because of the openness of the country in Oklahoma that the remaining cases were not verified as having touched down.

So we have great confidence in that technique of detecting tornadoes, or at least the circulation patterns aloft before tornadoes strike the ground.

I would like to point out a couple of other things that might have been unclear earlier. The NEXRAD radar algorithm to detect tornadoes is called the detection of a tornado vortex signature. This does not actually measure the tornado. In fact, measuring or detecting the tornado is very difficult.

There is something very fundamental in a radar that cannot be overcome physically. There is an inverse relationship between the maximum velocity that can be detected and the range to which the radar can detect that velocity.

The higher the velocity you wish to detect, the shorter the range at which you can detect that velocity, and vice-versa.

So given that limitation—in fact, to detect a wind speed of 140 miles per hour given the parameters associated with NEXRAD radar it gives you only a useful range of about 60 kilometers, around 36 miles, and 140 miles per hour is a very common velocity in a tornado.

Higher velocities require even shorter range. That is a fundamental physical limitation that just cannot be overcome, and consequently the best that we could hope to do is to detect the tornado's circulation, or tornado vortex circulation aloft before the tornado strikes at the ground. And as I have already indicated that is a very reliable technique as researchers in Oklahoma have shown.

Now, one more thing and I will quit. It should be noted that many of the modern advances in radar meteorology have taken place because of close cooperation between the federal agencies and the university community.

An excellent example is the relationship between the University of Oklahoma, the Weather Service and the National Severe Storms Lab in Norman, Oklahoma. They have formulated methods of detecting tornadoes and severe wind shear, clearly very important in Oklahoma.

We at Clemson have recognized the increasing demand for young scientists trained in the use of radar to observe the atmosphere, and have therefore been attempting to build a group; in radar over the past six years.

We have also attempted to forge a relationship with the weather service at Greer by seeking funding and support of acquisition of a weather radar at that site. The presence of an advanced radar at the jetport would considerably enhance our ability to train young students for careers in radar meteorology.

It would also yield valuable data which could supplement the meager radar information from Athens, Georgia that is currently available to weather service forecasters at Greer.

Certainly in a severe weather outbreak a forecaster would want to use every possible source of information to decide when and where severe storms would occur and whether to issue warnings concerning them.

We are convinced that an advanced radar of the type that I have described would be of immeasurable value in that regard.

Now, given the vagaries of the funding process, we cannot predict whether we will be successful in acquiring a radar, but if we do acquire such an instrument we believe there would be clear benefits to all parties concerned, including the general citizenry of upstate South Carolina.

Thank you.

[The prepared statement of Dr. Ulbrich follows:]

Testimony to be Presented

by

Carlton W. Ulbrich
Professor of Physics
Department of Physics and Astronomy
Clemson University, Clemson, SC

at the Hearing on

TORNADO WARNINGS AND WEATHER SERVICE MODERNIZATION

conducted by

U.S. House of Representatives
Committee on Science, Space and Technology
on
Tuesday, August 8, 1989
at
Spartanburg Technical College, Spartanburg, SC

I am a Professor of Physics at Clemson University and have been involved in atmospheric physics teaching and research for more than twenty years. My research has employed radar in a variety of experimental research projects. Among them are experiments designed to determine the effects of urbanization on the weather and to test our ability to suppress hail from large thunderstorms by seeding them with silver iodide. In addition, my work has involved development of methods by which radar can be used to measure rainfall amounts and toward determination of the effects of lightning on the distribution of precipitation particles in thunderstorms. In the conduct of this research over the past twenty years I have seen enormous advances take place in the ability of radar to accurately observe meteorological phenomena. I am confident that this capability will continue to improve in the future.

Radar meteorology is a relatively young field. The instrument was not used to intentionally observe weather until the early 1950's. The best that atmospheric scientists could do with radar during those early years was to detect the presence of precipitation. Today we have high confidence in radar as a technique to measure the amount of precipitation falling from clouds, to measure the sizes and shapes of precipitation particles, to determine the circulation patterns in clouds, to detect wind shear associated with downbursts from severe thunderstorms, to measure the winds in the clear air at high altitudes above the surface of the earth, to detect the presence of hail and intense cyclonic circulations (such as tornadoes) and much more.

Some of these capabilities are possessed by radars which are a part of the present National Weather Service network of weather radars. However, most of these advanced techniques are possible only with specialized, expensive radars located at a very few research facilities in the U.S. and overseas. The Weather Service radar network is aging and outdated and is scheduled to be replaced during the decade of the 90's with more modern and reliable equipment under project NEXRAD. These new radars will possess Doppler capability and should therefore be able to detect severe storm circulations. The savings in lives and property damage which should result from the early warnings made possible by these radars are obvious. However, because of limited federal funding much of what we scientists would prefer to see implemented on NEXRAD will have to postponed. We are hopeful that in the future sufficient resources will be found that the capabilities of these radars will be further enhanced through incorporation of modern research discoveries.

It should be noted that many of the modern advances in radar meteorology have taken place because of close cooperation between federal agencies and the university community. An excellent example is the relationship between the University of Oklahoma, the Weather Service and the National Severe Storm Lab in Norman, OK. These groups have worked together in the development of some of the most advanced meteorological radars in the world. They have formulated methods of detecting tornadoes and severe wind shear, clearly very important capabilities in Oklahoma. We at Clemson have recognized the increasing demand for young scientists trained in the use of radar to observe the atmosphere, and have therefore been attempting to build a group in radar meteorology over the last six years. We have also attempted to forge a relationship with the Weather Service by seeking funding in support of the acquisition of a weather radar which would be situated at the Greer jetport. The presence of an advanced radar at the jetport would considerably enhance our ability to train students for careers in radar meteorology. It could also yield valuable data which could supplement the meager radar information from Athens, GA that is currently available to weather service forecasters at Greer. Certainly in a severe weather outbreak a forecaster would want to use every possible source of information to decide where and when severe storms will occur and whether to issue warnings concerning them. We are convinced that an advanced radar of the type I have described here would be of immeasurable value in that regard. Given the vagaries of the funding process, we cannot predict whether we will be successful in acquiring a radar. But if we do acquire such an instrument we believe that there will be clear benefits for all parties concerned including the general citizenry of upstate South Carolina.

Ms. PATTERSON. Thank you very much.

Our next presentor does not have a name tag, but he represents Delta I believe, Delta Air Lines, Spartanburg-Greenville Airport. If you will identify yourself for us, please.

Mr. REDDICK. Thank you.

Good afternoon. My name is Chris Reddick, I am the manager for Delta Air Lines here at the airport. As you know, I do not have a name tag, so that means I am substituting.

And bear with me, I am a poor public speaker, and I am not a weather forecaster. I am simply the manager for the operation here in the upstate.

Delta has already been in contact with Ms. Patterson's office, and we wanted to relate to you the importance of this meeting here today and let you know how we really feel.

First of all, as you know, the jetport is presently under a major expansion and will soon have the capability of many additional flights. Without having reliable weather equipment in place in Greenville, our growth will definitely be hindered.

Some of the speakers here today have told you about the new Dopler radar system, which is a superior piece of equipment without any doubt. However, it does have its limitations, and it is just that, a piece of equipment capable of breaking down, and in severe weather not being any use at all, so this is a thing that does concern the air line industry as a whole.

We have been talking about severe weather for the most part here today. I wanted to bring you folks up to date as to what the weather does to Delta Air Lines. Right here today without weather we would not be able to land the aircraft. Today is a beautiful day, but we have got to have reliable weather in order to operate any flight into and out of any airport, so therefore we are very much opposed to closing any weather station at any major airport.

The other item that the Dopler radar has been brought to our attention that is of main concern to the air line industry is the backup system in the event of a power failure, or equipment nature or something of this nature, and that is to the air traffic control system which we definitely feel is already taxed to the limit.

As I have mentioned, everyday routine weather is what we have got to have on an everyday basis to operate into any airport.

Thank you.

Ms. PATTERSON. Thank you very much, Mr. Reddick.

We will now hear from Mr. Larry Holcomb, who is the Airport Operations Manager at Greenville-Spartanburg. Mr. Holcomb.

Mr. HOLCOMB. The Greenville-Spartanburg Airport is now the second busiest airport in South Carolina, serving over a million passengers a year. Our airport is also located in the busy corridor linking the Northeast with the South, and is only 150 miles from Atlanta, which is the second busiest airport in the United States. When the weather is bad in Atlanta, our airport is often an alternate, and often we receive 10 to 20 additional flights that were scheduled for Atlanta, making our airport even more critical for air line safety.

Despite Mr. Friday's confidence in the Dopler system, I would like to read a statement that recently appeared in "U.S. News and

World Report." They had quite an extensive article I think the 24th of July. They stated that:

> For all the advances in weather prediction brought about in the last decade by satellites, radar and supercomputers, when it comes to forecasting the most damaging of storms, meteorologists acknowledge that they are still coming up short.

The article also was very skeptical of the ability of even the Dopler radar to spot small tornadoes, the type that we most commonly have in the East, at distances greater than 25 to 30 miles. I think that has been brought out repeatedly here.

As Operations Manager at the airport, it is my responsibility to keep the airfield safe for all aircraft operations. This is not always an easy task. It requires coordination and support of many agencies located on and off the airport. If severe thunderstorms or storms with tornado-like winds strike the airport, an hour's warning can save the airport alone millions of dollars. If we are warned of storms which will bring sleet or ice buildup and can treat the runway with chemicals just prior to the beginning of precipitation, thousands of dollars can be saved, and the airport will be closed for the shortest possible time.

The National Weather Service located at the airport is very instrumental in providing critical information needed to maintain safety during inclement weather. Especially during the winter months, the face-to-face contact that we now have with the meteorologists on duty is invaluable. The airport does not feel that we can receive the same quality of service from stations located a hundred miles away from this airport.

Thank you.

Ms. PATTERSON. Thank you very much.

I have several questions, and I will just begin with the doctor if that is okay. I think you being a scientist maybe you can explain some of these things to me.

You mentioned in your prepared statement that some of the capabilities that you would have liked to have seen included in the NEXRAD program have been postponed due to lack of funds. Could you elaborate on that?

Dr. ULBRICH. The techniques used for measurement of precipitation falling to the Earth would be much better enhanced if the radars had been what we refer to as dual polarized. Given the present design of NEXRAD radars, that can only be accomplished with a major equipment modification in the future. That is one of the things that we would have liked to have seen built into the design at the outset.

We would like to see easier access to real time data than is currently available. We would like to see it currently available on the existing NEXRAD radars, which I think there is only one in place right now in Oklahoma.

We would like to see the possibility of control over scanning strategies. That would be one of the great advantages of Clemson University in cooperation with the Greer Weather Station acquiring their own radar, we would have control over strategies associated with scanning of the radar, for example going into sector scans and scanning to higher altitudes to get information regarding circulations more rapidly than it would in an operational mode.

Those are some of the examples I had in mind.

Ms. PATTERSON. You mentioned something that one of the people in attendance today mentioned to me, that there was discussion at one time about Clemson University having its own radar, or helping to get——

Dr. ULBRICH. Yes.

Ms. PATTERSON. Is that proposal still—who was that through, and is that still in the works?

Dr. ULBRICH. It was through me, and in cooperation with Wayne Jones at the Greer Weather Station.

The proposal originally would have one of the surplus radars which would become available after replacement with a NEXRAD radar go to the weather station, and we would acquire the funds from the state, and possibly from other agencies to modify it and make it a true research radar with Dopler capability and dual polarization and so on.

Ms. PATTERSON. Is that conversation still going on? Is that still a possibility?

Dr. ULBRICH. On my end I will hear about Clemson's commitment to the program this month from the state regarding the possible commitment of Cutting Edge Research funds toward that program. You would have to talk to the weather service about their part.

Ms. PATTERSON. Is that something that we could cooperate and work together on as we look down the way of how we can modernize or update our existing weather station? If in fact NEXRAD is not located in our area, is that an alternative?

Dr. ULBRICH. It is an alternative in my mind, but I believe the weather service might have difficulty with that as an operational radar. As a research radar and as an input to the forecaster in putting a forecast together with respect to severe weather and other types of weather, I think it would be of great value, but in an operational mode I think they would have difficulty with it.

Ms. PATTERSON. Well, I certainly will ask the committee to have some conversation with the weather service about that if that is a possibility.

Dr. ULBRICH. Thank you.

Ms. PATTERSON. I do not know who is the best to explain this to me, but what is the difference in radar used for aviation and weather? Do you use the same type? What do we have at Greenville-Spartanburg now? Do we have any——

Mr. HOLCOMB. No, we do not have any radar capabilities at the airport.

Dr. ULBRICH. If you mean an air traffic control radar, that is quite different from a weather radar, that is quite different from a weather radar.

Ms. PATTERSON. I guess that is what I am asking, you do have an air traffic control radar, but it does not detect any weather?

Dr. ULBRICH. It attempts to remove it with a technique called moving target indicator. It attempts to remove the weather clutter as they refer to it so that only aircraft are shown.

Ms. PATTERSON. But you need both I think I was hearing?

Dr. ULBRICH. Oh, surely.

Ms. PATTERSON. I think most of us are fully aware—maybe I am—I think I hear this, that most of the—well air lines really depend on weather because so many of the accidents are related to some sort of weather pattern or—not necessarily severe, but just the wind flows and whatever. Is that fairly accurate?

Dr. ULBRICH. That is correct.

Mr. REDDICK. Something else, Ms. Patterson. On the winds and temperature, a lot of people do not know, but the aircraft itself is designed to take off—the temperature, winds and the altimeter, all of this has a direct bearing on how much an aircraft can actually take off with. The higher the temperature, the less weight you can put on the airplane, and so this is why the weather is just as critical today as it would be in a severe thunderstorm for us. The higher the temperature, the less we will be able to put on the airplane and actually take off on the ground.

Ms. PATTERSON. We had a question down that I was to ask, and I may have sort of alluded to it, but the question was what type of radar system is used by the Spartanburg-Greenville—you notice I put Spartanburg-Greenville, I guess it is Greenville-Spartanburg Airport, Greer Airport, whatever—what type of radar system is used at the airport, and does the FAA have any plans to install any kind of new system that you know of at that airport as we grow?

Mr. HOLCOMB. Just the air traffic control radar is the only type radar we have, and I am not sure what their——

Ms. PATTERSON. Any changes as that airport grows and the congestion increases?

Mr. HOLCOMB. Well, we hope so, but I cannot answer that question.

Ms. PATTERSON. I have just had a question handed to me. Let me see if I can ask—will the implementation of NEXRAD at the Greenville-Spartanburg Airport have an effect on an air line's decision to use Greenville-Spartanburg as a hub terminal?

Mr. REDDICK. Somebody is really trying to put us on the spot, are they not? [Laughter.]

Ms. PATTERSON. And I do not even know who handed me that.

Mr. REDDICK. Well, let me answer, because I guess I can speak for Delta. You know, we are within 140 miles of one our major hubs, so quite honestly Delta would not want to consider locating a hub at the Greenville-Spartanburg Airport due to this. Charlotte on the other side has got U.S. Air, and they probably would not.

The equipment available here today would I am sure have an impact on whether another air line would want to make a hub in the Greenville-Spartanburg Airport.

Ms. PATTERSON. Does the Greer Weather Station provide localized pilot weather briefings?

Mr. REDDICK. Yes, ma'am, and that is what we have got to have. That is what is crucial to all air line operations.

Ms. PATTERSON. So our local weather station does that?

Mr. REDDICK. They furnish the information to the office in Kansas City—and I am a layman on this, I do not know a whole lot about how it works—but they furnish it into Kansas City, and then it comes back to us in an hourly forecast, and then special forecasts.

Ms. PATTERSON. Well, I appreciate you gentlemen being here and helping us as we ask questions dealing with our weather service in the upstate. You all may be excused.

I had a couple of questions or statements that maybe Dr. Friday and Wayne, maybe I could ask you that have come up through the day. Maybe if you all would—I do not want to put you on the spot, but maybe if you all will return, I just had one or two things that came up, and then we will adjourn almost on time.

Let me again emphasize to the folks in this room I am not on the subcommittee or the committee that deals with weather, the weather stations. The two gentlemen that were here are on that committee. The testimony that will be taken today, both those who brought witnesses and those who have presented written documents, will go to that subcommittee and we will continue to work with them.

Dr. Friday, because I heard several people, the gentleman from Charlotte and of course the people from our area, talk about the concentration of population and how this part of the state now does have one-third of the population, do you consider population concentration when you make selections for service from the National Weather Service?

Dr. FRIDAY. Let me try to go over the steps that we took actually in the decisions on where the radar sites would go, where the office structure would be positioned and so on.

What we started with was the requirement, and I think everyone will agree with it, to watch the coastal areas very closely for the hurricanes coming in and the coastal storms, so we positioned the radar network very densely right along the coast line all the way around, and then we started to move in from there to try to locate positions where we currently had offices if at all possible to prevent major numbers of people moving and so on. We tried to look at the population centers, we tried to look at the severe weather patterns, the various weather patterns, the air line patterns, et cetera, and we tried to make sure that we had a uniform coverage across the country. We believe that we succeeded in that in the eastern part of the country east of the Rockies. There are a few gaps as you have seen in the strategic plan out in the intermountain West.

Now, when you do that you start to make compromises as to exactly where you will locate based on all of these various factors. There are certain sections of the United States where we have less optimum coverage than others, and I think that may be a situation that we have here in the Greenville-Spartanburg area in the whole portion here in western Carolinas. What we have—there are other sections of the country too, this is not the only one in which we are on the edge of radar coverage if you will, but we still feel based on the experience that we have had that we will still have adequate coverage here.

As I was explaining to someone as they pressed me outside, I do not have the same degree of confidence that we will be able to provide the Secretary of Commerce clear objective evidence of no degradation of services here as I do in other sections of the country, because I think the probability here is a little less than certain. I still believe we will be able to do it, but it is probably at a 60–40

ratio as opposed to a 95–5 ratio as it is in some other sections of the country, and we will have to test that, we will have to make sure as we go through there, but we do take into consideration population, we do take into consideration severe weather, and we do take into consideration air line traffic, et cetera.

Ms. PATTERSON. Let me say with Wayne sitting beside you, we really appreciate the weather service that we have gotten from Wayne and the others who work with him. I think there are some others in the audience who work with him. We appreciate not only at the time of severe weather, but at other times. We believe we have an excellent office, and I think that is why you saw so many people turn out today. They believe that that office serves a purpose, whether it is for the schools or for businesses, or for just those of us who live in the community and are concerned about our welfare, so we appreciate the service that Wayne and his people give to us.

Dr. FRIDAY. If I could say one other thing, I certainly appreciate you asking me here to testify today. I think it has been very useful for me in understanding exactly what the sensitivities are, what the concerns are for the local communities.

I also recognize Wayne's performance. If Wayne was not doing a very good job, we would not have this hearing here today. That is a very clear thing. And certainly Wayne Jones has done an outstanding job here with the staff in coordinating with that, but that also goes for your local officials here that have worked very closely with him. It takes both sides of this to work.

We have a very difficult task ahead of us as we go through restructuring weather services around the country, not just here in the Carolinas, but around the country, to make sure that we maintain those close relationships with the emergency management people, with the aviation community and the like, and to make sure that all those services are indeed provided. It is not an easy job I might add, but it is going to be one that we will all have to work together on.

I appreciate as I said you holding this hearing here today, because I have a much better feeling for exactly what the local issues are, and I thank you for that.

Ms. PATTERSON. We appreciate your coming.

Let me say to Dr. Friday that the reason we did hold this hearing is we think that it is important that the people in the area have the opportunity to express their concerns, and as he stated now he has picked up some information from our meeting today that maybe he was not in tune with, and I think I have picked up that there are gaps in western North Carolina and this part of South Carolina as far as maybe the NEXRAD coverage. I think we have all learned a great deal, and I would say to you, Dr. Friday, I hope that you will take this message back to the administration and tell them as we look at modernization and as we look at how best to spend our dollars for weather service and service to people that we will consider this area and the service that our people need.

We appreciate everyone who has been here today. Anyone who wants to remain after we will be here for a few minutes, but if there is anyone who wants to put in a written statement, whether

it is a sentence or two or whatever that you have on your mind, please feel free to give it to our office so that we can submit it for the record.

Again let me assure you, as you heard Dr. Friday say, our weather station will not close. The only closures that will take place will not take place until after 1993, and I believe the information that he has gotten today shows him that there is a need for our weather station to modernize and to work with them as we serve the people.

Thank you very much for being here, and thank you, Dr. Friday, and thank you, Wayne.

[Applause.]

Ms. PATTERSON. I should have thanked you all again, the staff that does everything and does not complain.

[Whereupon, at 12:48 p.m. the hearing was concluded.]

APPENDIX

Pickens County
Emergency Preparedness Agency

WILLIAM D. EVETT
DIRECTOR

EMERGENCY OPERATIONS CENTER
304 Pendleton Street
PICKENS, S.C. 29671

TELEPHONE 878-7890
FAX 878-7846

STATEMENT OF

WILLIAM D. EVETT, DIRECTOR OF THE
PICKENS COUNTY EMERGENCY PREPAREDNESS DEPARTMENT

TO

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

AUGUST 8, 1989

Pickens County, with a population of approximately 90,000, is served by the Greer Weather Station.

We rely heavily on this station for weather advisories as we experience severe winter snow and ice storms, flash flooding, tornados, severe thunderstorms and drought conditions. Also, should we have a hazardous materials accident or an accident at the fixed nuclear power plant, which is located on our west boundary, we would need immediate weather data in order to conduct appropriate emergency response and evacuations of down wind areas.

The working relationship between the Greer Weather staff and Emergency Preparedness couldn't be better. We have a mutual professional trust and when we call one another it is not just a voice on the phone.

Taking into consideration the limitations of the new radar system, and yet not forgetting the positive features, I propose the following:

Maintain the Greer Weather Station at its current location and upgrade their capabilities with modern technology and equipment.

The terrain of the ten counties served by Greer, with a population of 1.4 million, is difficult enough to forecast and monitor from the Greer location. I dare to imagine what will happen if our closest weather station is Columbia, 125 miles away, or Atlanta, 150 mile away.

The use of weather spotters and local government emergency services to report actual occurrences will become more expensive due to long distance phone cost. I fear this will dampen an effective program.

I urge your most serious consideration of this situation. Your final decision must be what most effectively saves the lives and property of those who support us.

Statement in Support of Retaining the Weather Service Office at the Greenville/Spartanburg South Carolina Airport

Mr. Chairman, we would like to add our comments to the testimony on the continued operation of the weather service office at the Greenville/Spartanburg Airport.

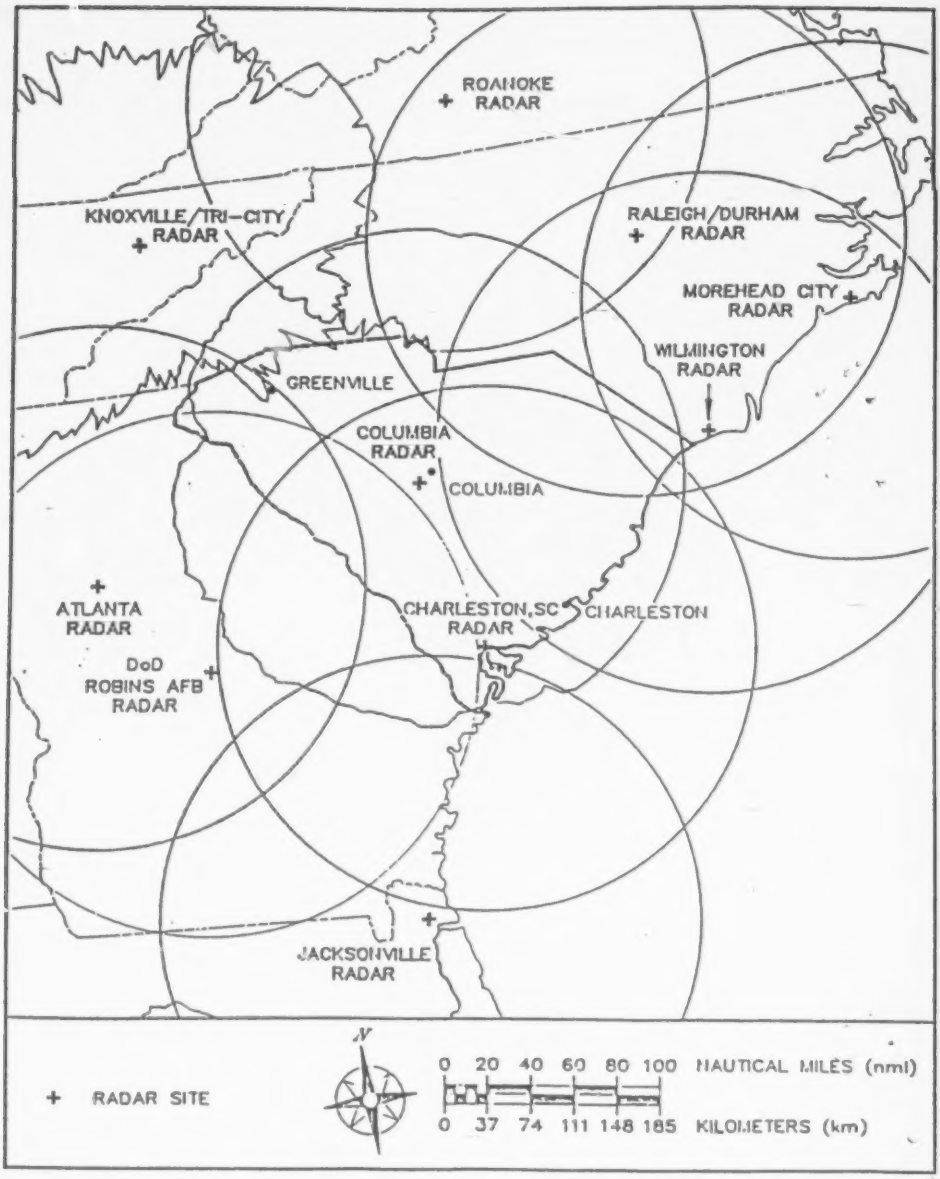
We have reviewed the strategic plan for modernization of the National Weather Service. Obviously, we are in support of the most efficient delivery of weather service possible. However, we do not believe that the proposal provides sufficient justification for the local Greenville/Spartanburg weather station to be eliminated without having an adverse impact on the upstate of South Carolina. The upstate has the most hazardous weather during the winter months, the largest school district, the most air carriers, plus the largest concentration of people needing to be served in the state. Tornados which hit this region this summer and the large snow storms of past winters suggest the need for enhancing our current facility rather than relying on the Dobler radar to service the upstate from Columbia.

Given the view of Nexred coverage of South Carolina at 10,000 feet, it would appear that a better balance of coverage in the upstate would be provided through the location of radar in the Greenville Spartanburg area rather than in Columbia.

Thank you for the opportunity to comment. We hope we will be able to sustain the fine service we have had from the NWS in the upstate.

Sincerely,

Harvey A. Schmitt, CCE
President



NEXRAD COVERAGE OF SOUTH CAROLINA AT 10,000 ft

A RESOLUTION

REQUESTING CONGRESS AND THE NATIONAL WEATHER SERVICE TO KEEP OPEN THE GREER WEATHER SERVICE OFFICE UNDER THE NEW MODERNIZATION PLAN.

WHEREAS, the National Weather Service is proposing to close the Greer Weather Service Office at the Greenville-Spartanburg Airport; and

WHEREAS, the Greer Weather Service Office is a crucial office and provides forecasts and severe weather warnings to ten counties in the upstate of South Carolina; and

WHEREAS, the service provided by this particular office is a vital resource for emergency planning; and

WHEREAS, the South Carolina Emergency Preparedness Association firmly believes that closing the Greer Weather Service Office would be a mistake and would have lasting detrimental effects on the citizens of the upstate.

NOW THEREFORE,

BE IT RESOLVED by the members of the South Carolina Emergency Preparedness Association:

THAT the membership of the South Carolina Emergency Preparedness Association, by this resolution request Congress and the National Weather Service to keep open the Greer Weather Service Office at the Greenville-Spartanburg Airport.

BE IT FURTHER RESOLVED that a copy of this resolution be forwarded to the President of the United States Senate; the Speaker of the United States House of Representatives; the Committee on Science, Space and Technology; and the executive director of the National Weather Service.

We hereby certify that the foregoing is a true and correct copy of a resolution passed by the membership of the South Carolina Emergency Preparedness Association on this 9th day of August, 1989.

Victor C. Jones
President

Ernest L. Turner
President Elect

Marybeth Solesbee
Secretary

Betty S. Polk
Treasurer

UNC CHARLOTTE
The University of North Carolina at Charlotte
Charlotte, N.C. 28223

Department of Political Science
(Chairman) 704/547-2573
(Faculty) 704/547-2571

September 8, 1989

Emergency Preparedness Citizens'
Advisory Committee
Mecklenburg County
600 East Fourth Street
Charlotte, North Carolina 28202

The Honorable James Scheuer
U.S. House of Representative
Suite 2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Representative Scheuer:

I am writing to express the grave concerns of the citizens of Mecklenburg County regarding the proposed closure of the National Weather Service offices in Charlotte, N.C. The Emergency Preparedness Citizens' Advisory Committee is a Charlotte/Mecklenburg County advisory board appointed by the county commissioners to provide advice on issues related to potential natural and man-made emergencies or disasters in our county and to act as a partner in ensuring that appropriate planning is in place to protect the citizenry from these events. Another responsibility of the committee is to provide the citizens of Mecklenburg County with the information they need to respond in the event of an emergency. The closure of the Nationmal Weather Service office in Charlotte will make that task nearly impossible.

Dr. Friday's committee that examined the need for Weather Service offices and the possibility for moving some of them to other locations, listed three criteria that they would use in guiding their recommendations. They are: 1).protection of coastal areas, 2) amount of air traffic in the affected area, and 3). the size of the population in the area. Based on these criteria, the recommendation to close the Charlotte office and to move it to Columbia,S.C. makes little sense, since it fails on two of the three criteria set out by the committee in advance of their study. Charlotte has substantially more air traffic than Columbia and its region, and Charlotte has the largest population of any area between Atlanta and Washington, D.C. Any recommendation that violates two of the three criteria determined to be most important in making these decisions is difficult to understand.

There are additional concerns that also appear not to have been raised or addressed in the Friday recommendations. First, Doppler radar has a range of 125-200 miles; however, it doesn't pick-up weather under 10,000 feet beyond sixty miles. This leaves the metropolitan Charlotte area in a vary precarious position since much severe weather that would adversely affect this area would not be picked up by a radar in Columbia, SC.

The University of North Carolina is composed of the sixteen public senior institutions in North Carolina
An Equal Opportunity/Affirmative Action Employer

Second, the Weather Service is used very frequently for other purposes than a tornado or severe weather warning or watch. We have one of the nation's highest concentrations of nuclear power plants in the metro area. Specific and detailed weather information is essential for these facilities. Duke Power and Southern Bell rely on the Weather Service for much of their load and crew planning. Winter storms in particular are a major concern of school systems in this area, where snowfall, etc. may vary by several feet within a mile of two different locations in the city because of the confluence of mountain and piedmont weather systems. The schools rely on the weather radio activation, yet this issue is not addressed as a consequence of moving the office from Charlotte.

Third, activation of the Emergency Broadcast System is not addressed. There are no provisions for cross-state activation of the system now. A South Carolina order would not reach North Carolina.

In conclusion, an effort to save a little money by closing Weather Service offices does not appear to warrant the placement of 1.4 million people in substantial jeopardy through lack of information to allow emergency systems in the public and private sector to adequately prepare for threatening weather situations. The Friday commission recommendations themselves violate their own stated criteria. If there are other criteria, then they should have been stated. Protecting people along the coast is important, especially during the peak summer months, but does that justify leaving millions of people rather poorly protected during twelve months every year? I think not.

We strongly urge that you maintain the Charlotte National Weather Service office. If nothing else, it will save our committee much time and resources in having to inform our citizens about their increased risk, and it will save the local area much money that will have to be spent because the ability to prepare for and thus to mitigate damage from destructive weather will be greatly diminished. Saving money at the federal level that costs an equal if not greater expenditure at the local level js a short-sighted decision at best and an insidious one at worst. We strongly urge you to do all that you can to make sure that the Charlotte office of the Natonal Weather Service remains open.

Sincerely,

Terry Rhodes

Terrel L. Rhodes, Chair
for the Emergency Preparedness
Citizens' Advisory Committtee

STATEMENT ON PROPOSED CLOSING OF NATIONAL WEATHER SERVICE OFFICES AT:

GREENVILLE-SPARTANBURG, SOUTH CAROLINA
ASHEVILLE, NORTH CAROLINA
CHARLOTTE, NORTH CAROLINA

JOHN C. PURVIS, DIRECTOR
DAVID J. SMITH, REGIONAL CLIMATOLOGIST
SOUTHEAST REGIONAL CLIMATE CENTER
COLUMBIA, SOUTH CAROLINA

The following statement was prepared at the request of Elizabeth Patterson, Representative to the United States Congress, 4th Congressional District of South Carolina:

The proposed closure of three National Weather Service Offices (WSO) in the Western Carolinas will cause a significant void in local and regional climate services which cannot be replaced by current and possibly future technology. We strongly urge the National Weather Service (NWS) to reconsider the closure of these important WSO's in their Modernization and Restructuring Plan.

There are several urgent reasons which point to locating a WSO in the Western Carolinas:

1. The natural west-to-east progression of weather across the region, plus the blocking effect of the Appalachian Mountains to the west, causes a distinct difference in day-to-day weather as well as the long term climate of the Western Carolinas. A fully staffed and operational WSO is needed to detect these differences so as to provide adequate warning of severe weather occurrences and acute spring freeze episodes. Additionally, during the year as the peach and apple crops develop and mature, the services of a trained professional staff resident in the region is an invaluable asset. The prevention of catastrophic loss of fruit and vegetable crops in one year would offset the costs of a WSO for one year.

2. The potential for loss of life and property from flash flood episodes remains very high across this region. No other place in the Carolinas is more prone to flash floods than Upstate South Carolina and Western North Carolina. Flash floods are short fuse catastrophic events that develop suddenly and with increased frequency as you move from the piedmont into the mountains. While no one can control weather or individual storms, a WSO station in the area alerted to this hazard can provide the short notice warning necessary to save lives. Also, through day-to-day contact with people in the flood prone areas, adequate preparedness measures can be kept in place and viable.

3. There is a much higher incidence of tornadoes and locally damaging storms across the Western Carolinas than in other portions of the Southeast. The services of a WSO, and more specifically of the Greenville-Spartanburg WSO, during the April 4, 1989 and May 5, 1989 tornado and severe weather episodes proved once again the need and value of having a local, fully staffed WSO in the Western Carolinas.

4. Climate and weather varies widely in a relatively short distance from the mountains to the sea in the Southeast. Annual rainfall amounts can differ by 20 inches over a 25 mile distance in the Appalachian Foothills. Record cold temperature extremes in South Carolina, for example, range from 5 degrees in Beaufort to -19 degrees at Caesars Head. The ability and expertise to provide more accurate day-to-day forecasts cannot be achieved through technological advancement alone. The local WSO concept, especially in marginal coverage areas by NEXRAD, will continue to provide accurate, timely, and applicable services to meet the needs in the Western Carolinas. Automation of weather observations and forecasts without a local WSO attuned to the needs of the local community and economy will reduce the overall effectiveness of the weather and climate services provided.

The modernization and restructuring of the NWS is a step forward for weather services in the United States. The closure of WSO's in the Western Carolinas, however, will decrease accurate and timely weather services to an area already lacking in current radar and observing technology. The Upstate South Carolina and Western North Carolina counties are expected to grow rapidly in population and economic resources. Population density along the 'Interstate 85 Corridor' from Atlanta, GA to Raleigh, NC exceeds that of most areas in the Southeast. Population growth estimates by the Strom Thurmond Institute for Government and Public Affairs at Clemson University indicate that nearly 3 million people will live along the 'Corridor' by the year 2000. Increasing population results in higher vulnerability to loss of life and property from catastrophic weather events. The population statistics combined with the educational and economic benefits alone point toward an increasing need for local weather and climate services in this region and should discourage any plans to close WSO's.

Respectfully submitted,

John C. Purvis
Director

David J. Smith
Regional Climatologist

Southeast Regional Climate Center
1201 Main Street, Suite 1100
Columbia, SC 29201
(803) 737-0800

CLIMATE INFORMATION NEEDS IN THE SOUTHEAST UNITED STATES

Southeast Regional Climate Center
South Carolina Water Resources Commission
Columbia, South Carolina

National Climate Program Office
National Oceanic and Atmospheric Administration
United States Department of Commerce
Rockville, Maryland

July 1989

CLIMATE INFORMATION NEEDS IN THE SOUTHEAST UNITED STATES

Peter J. Robinson
Department of Geography
University of North Carolina
Chapel Hill

Principal Contributors:
James Coffey, South Carolina Water Resources Commission
Jerry M. Davis, North Carolina State University
Thomas Gleeson, Florida State University
Richard McNider, University of Alabama, Huntsville
Patrick J. Michaels, University of Virginia
Gayther Plummer, University of Georgia
John C. Purvis, Southeast Regional Climate Center
Scott Sidlow, South Carolina State Climate Office
David J. Smith, Southeast Regional Climate Center
Wes Tyler, South Carolina State Climate Office

FINAL REPORT
NOAA Grant No. NA88AA-D-CP041

Southeast Regional Climate Center
South Carolina Water Resources Commission
Columbia, South Carolina

National Climate Program Office
National Oceanic and Atmospheric Administration
United States Department of Commerce
Rockville, Maryland

JULY 1989

ACKNOWLEDGEMENTS

Funding for the Climate Information Needs Assessment was provided by NOAA through the National Climate Program Office (Grant No. NA88AA-D-CP041).

The active cooperation of the personnel of the National Climatic Data Center, who freely made available their user request records and provided much encouragement and support, and many valuable insights into user services, was vital for the success of this endeavor.

The personnel of the Climate Analysis Center and of the other Regional Climate Centers were unfailingly helpful in discussing their perspective on the provision of user services. Members of the staffs of the state Agriculture Weather Offices in North and South Carolina, and of the National Weather Service Center at Auburn, Alabama provided invaluable information concerning services to agriculture.

This assessment would not have been possible without the support and assistance of the State Climatologists from Alabama, Florida, Georgia, North Carolina, South Carolina and Virginia.

Special credit is due Mr. James Coffey, for planning how the assessment would be done and for conducting the major portion of the collection and analysis of the information.

Mr. Scott Sidlow and Mr. Wes Tyler, Assistant State Climatologists for South Carolina, also provided outstanding support and technical assistance.

Credit also goes to Mr. David J. Smith, Regional Climatologist, for arranging printing and assisting in the final layout, to Mr. Grant Goodge, National Climatic Data Center, for superb photography, and to Susan Branham and Malynn Drescher, SC Water Resources Commission, for the quality drafting.

The assistance of these many individuals and groups is gratefully acknowledged.

Additional copies of this assessment are available by writing:

John C. Purvis, Director
David J. Smith, Regional Climatologist
Southeast Regional Climate Center
1201 Main Street, Suite 1100
Columbia, South Carolina 29201

CONTENTS

Executive Summary 4

The Need for Climate Services 5

The Southeast Regional Climate Program 6

Climate Information Producers 7

Users and Their Requests 11

Assessment of Users Needs 17

Met and Unmet Needs 21

Meeting the Needs 25

Appendix 1: State Climatologist Addresses 28

Appendix 2: Historical Climate Network 29

LIST OF TABLES AND FIGURES

Figures

Figure 1: The Southeast Regional Map 32

Figure 2: Total Requests from the Nine Major User Classes in the Southeast 33

Figure 3: Requests of Climate Data By State 35

Figure 4: Types of Climate Information Requested 34

Figure 5: The Value of Climate Information 36

Tables

Table I: Major Climate Information Producers 8

Table II: Steps Necessary to Develop Southeast Region Climate Program 11

Table III: Estimates of the Number of Different Users Requesting Climate Information in 1987 13

Table IV: Typical Types of Users and Requests 14

Table V: Assessment of Users by the North Carolina Agricultural Weather Program 14

Table VI: Alternative Sources of Climate Information 16

Table VII: Basic Categories of Users of Climate Services 19

Table VIII: Major Areas of Users Needs and Current Level of Service 22

Executive Summary

This document presents recommendations for the development of a Regional Climate Program for the Southeast United States. This covers the states of Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia, with the Regional Climate Center located in Columbia, South Carolina. The program is part of the developing nationwide system of climate services and is designed to:

— improve productivity, efficiency and cost-effectiveness for all sectors of the economy of the Southeast United States,
— provide information on the state of the atmosphere for use in management and public policy decision-making.

These recommendations were developed from an assessment of the needs of actual and potential climate information users in the region. This assessment identified the producers of climate information, analyzed the information requests they receive, and discussed information needs with users. Major results are presented here.

The major recommendations are to:

- **Develop guidelines for, and establish an effective and efficient climate information delivery system for the Southeast United States.**
- **Establish and maintain close links with the user community to ensure that high quality and useful data information products are developed and provided.**
- **Encourage continued development and strengthening of the individual State Climate Programs in the region.**
- **Establish priorities for the development of information products, based on past climate records, which are useful to decision-makers.**
- **Develop a system to ensure that the record of recent climate is readily accessible to all users, while emphasizing that data are preliminary and unverified.**
- **Explore the potential uses of the currently available climatic forecasts and their associated products.**
- **Establish methods for the dissemination of general information about climate and climate change, and for education about the appropriate use of climate information.**

Development of a Regional Climate Program will enhance the level of climatic services available in the region, enhance awareness of climate and its impacts, benefit the users of climate information and, through them, the region and nation as a whole.

The Need for Climate Services

As a nation we are becoming more and more sensitive to climate and its variations. Fluctuations in climate influence the productivity and efficiency of many sectors of the economy. Indeed, as the 1986 drought demonstrated, a major climatic event in one region can affect all aspects of the region's economy and have nation-wide, or even world-wide, impacts. Such events may increase in frequency, magnitude and severity as a result of climate changes arising from the greenhouse effect. In order to anticipate and respond to these changes, avoiding the disasters and seizing the opportunities they present, there is a need for decision makers at all levels to have ready access to the best climate information available.

At present there is no shortage of climate "data" — the numbers coming from the many observations we make of our climate. There is also some climate "information" — the translation of those numbers into a form which can help the decision maker. However, it is clear that only a small amount of the information which could be obtained from the presently available data is actually being created. **Thus information of potential benefit to the nation and its citizens is being lost.**

The National Research Council[1], recognizing this loss and responding to the vital need for climate information identified in the National Climate Program Act[2], recommended that a series of regional programs be established for the development and dissemination of climate information. These would utilize the resources of the federal, state and local governments, educational and research institutions and the private sector, to provide an information service of benefit to the region and ultimately to the nation as a whole. Following the National Research Council recommendations, there has been a slow, considered and ordered development of regional programs, with four in existence by 1988. Each is designed to meet the unique needs of its region. Some provide general information, others provide highly specific information to particularly vital economic sectors. All have a common mission. Thus:

The mission of the Southeast Regional Climate Program is to provide high quality, timely and pertinent climate data and information to users in the region. This includes:

— identification of current data needs;
— establishment of a system to ensure that high quality data are readily available;
— identification of current and future information needs;
— development of needed information products;
— dissemination of these products.

For the Southeast United States it was deemed advisable to initiate the program by assessing the needs of the region's users and then developing the program in response to these needs. This document presents the results of this assessment and provides recommendations for the further development of the Southeast Regional Climate Program.

---

[1]National Research Council, 1982: *Meeting the challenge of climate.* Washington, DC, National Academy Press 66 pp.

[2]National Climate Program Act of 1978, as amended (P.L. 95-367)

Increased use of historical information on severe weather events by the National Weather Service and emergency management agencies serves to educate the public about the dangers associated with lightning. For the period, 1959-1987, 2486 injuries and fatalities were due to lightning in the Southeast. In Florida alone, 1038 fatalties and injuries were recorded. In addition, lightning causes millions of dollars of damage to structures and communications equipment each year.

The Southeast Regional Climate Program

The Southeast Region is defined as the states of Alabama, Florida, Georgia, North Carolina, South Carolina and Virginia (Figure 1), an area with a broadly similar type of climate and economy. The Regional Climate Center has been established in Columbia, South Carolina.

The Southeast Regional Climate Program, in common with all other regional programs, is a cooperative venture involving federal and state entities. At the state level, each state has an individual designated as the State Climatologist who is that state's representative to the Regional Program.[1] The State Climatologist is responsible for providing climate information and services within the state. Some states have established formal State Climate Programs, consisting of the State Climatologist and a broader group of co-workers, to better serve state needs. Although the

[1]A list of State Climatologists is given in the Appendix.

level of service varies from state to state, the climate services effort in each state constitutes an integral part of the Regional Program. At the national level, there must be close cooperation with various federal agencies. The National Climate Data Center, the Climate Analysis Center, and the various National Weather Service Offices in the region, all part of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, have a vital part to play in the program. Other agencies, including the U.S. Geological Survey, the U.S. Department of Agriculture, and the Environmental Protection Agency, are involved through their various interests in atmospheric conditions.

The mission of the program includes all aspects of climate. The term "climate" here can be thought of as the "synthesis of the weather," commonly emphasizing the mean conditions and the variations about that mean, with extremes often being of great importance. Similarly, the elements of climate are everything which constitutes weather. Thus, while temperature and precipitation are major climatic elements, clouds and moisture, winds and sunshine, frost and fog must also be included. The chemical constituents of the atmosphere, and features such as air pollution, are now regarded as part of climate. Although the program excludes provision of the general day-to-day weather forecasts which are already easily available from a number of public and private sources, the program has a vital role in the generation of the specialized forecasts needed for activities such as agricultural or energy production.

Experience with current state services indicates that there are many user types, and many types of need, in the region. It was deemed essential, therefore, to clearly specify those needs prior to embarking upon a complex program, so that the program could effectively and efficiently use its resources to meet the needs of the region. Thus the first step, as indicated previously, was to **assess the user needs,** with the results being used as the basis for the **development of a responsive program.** The objectives of this "User needs assessment" were:

(1) specification of the information resources currently available, by identifying the **climate information producers;**
(2) identification of **users and their requests,** from the records maintained by the major climate information producers; and
(3) **assessment of user needs** by investigation of the needs of selected actual and potential users of climate information in the region.
(4) determination of current **met and unmet needs** to identify those areas where a regional program has a vital role to play; and
(5) development of a strategy for **meeting the needs,** which provides the recommendations for program development.

Each of these objectives is considered in turn in the following sections.

Climate Information Producers

The role of any producer of climate information is conceptually very simple: to analyze the observational data so as to provide scientifically sound information which is readily available in an understandable form to the ultimate user. Because there are many steps involved in this process, and many types of useful information, several producer institutions have been established. The nature and scope of these institutions must be identified, so that all necessary steps can be taken to ensure that the Regional Climate Program fulfills its mission of ensuring that information needed by users in the region is provided in the most efficient and effective manner.

Any information producer must be involved to some extent in the whole of the information creation process. This starts with the actual observation of a climatic element at a particular time

and place. Observations must then be checked for accuracy, recorded and sent to a central collection point. There they must be rechecked, corrected if needed, and archived. This archive then forms the database from which the various information products are developed. Analyses of the observational record in this database can then be undertaken to create the required information products. For some people the requirement may be for up-to-the-minute weather forecasts, others may need past climate records, while yet others may desire long-range forecasts. Some may need information about a single element such as wind, while others may be concerned with many elements simultaneously. The need may be for conditions at a point, or for a summary of conditions over a county or state. Thus "climate information" refers to a whole variety of products, their only common element being that they refer to atmospheric conditions and its direct effects. The needed products may range from the raw observational data through data summaries to analyses which provide information directly applicable to decision making.

Each of the major climate information producer groups active in the southeast (Table I) have developed distinct roles in climate information production, either concentrating on specific steps in the information creation process or on specific information products. While they are clearly distinct, they are also highly interdependent. Thus it is necessary to examine the roles and interactions of each as the first step in defining the potential role for a regional center as a producer of climate information.

TABLE I: Major producers of climate information active in the southeast United States

Meeting the needs of the general public and specialized users:

- Climate Analysis Center
- National Climatic Data Center
- National Weather Service Offices
- State Climatology Offices

Mainly meeting the needs of specialized users:

- Agricultural Weather Offices
  - Federal — Auburn, AL, for AL, FL, GA
  - State — Raleigh, NC, for NC
    - Clemson, SC, for SC
- Private Meterological Services and Climatological Consultants
- Research Personnel, commonly university based

The **National Climatic Data Center**, part of the National Archives, is the depository for all official weather observations made in the United States. The majority of these observations are made by the National Weather Service and its cooperating federal agencies. In addition, the National Climatic Data Center archives many international and local records. An integral part of this archiving is the quality control of the observational records received. Equally vital, the Center must respond to requests for any and all items from its archive in a timely manner. In-

deed the National Climatic Data Center, as the official archive and data source, has a key role to play in the development of any climate information product. To a very great extent the whole of our climate information system depends upon its smooth and efficient operation.

The individual **State Climatologists** play a complementary role to the National Climatic Data Center at the state level. They are local contacts for data and information, and commonly have close contacts with the end users of the information. Thus they are in a position to know, understand and meet real user needs. Many of the data they use come from the National Climatic Data Center, but they also archive local observations taken by state and local governments. In general the State Climatologists provide not only observational data but also summaries and analyses. In many cases these analyses have been undertaken and published by the State Climatologist specifically to address particular needs within that state. At present each State Climatologist acknowledges specific strengths and weakneses in the types of services offered. Potentially a major role of a regional climate program is examination of these strengths and weaknesses and the provision of assistance in the strengthening of services available to the individual states.

A group which also serves as a prime producer of climate information is the **Climate Analysis Center** of the National Weather Service. In contrast to the first two, which are mainly concerned with highly accurate quality controlled data referring to past conditons, the Climate Analysis Center focuses more on the rapid analysis of the current atmospheric situation. Its main concerns are the monitoring of developing situations such as drought, the production of outlooks for 30 and 90 days into the future, and the creation of techniques for combining forecasts and past climate information for decision-making. Thus the Climate Analysis Center requires not only the long-term climatological data from the National Climatic Data Center and the State Climatologists, but also the short-term international weather observations obtained from the World Meteorological Organization. It in turn makes available these observations, and its own products, to other groups. Some state programs already use these products, and their use and value should be further explored.

The local **National Weather Service Offices** are also both users and producers of climate information. As the site of many observations which are eventually archived at the National Climatic Data Center they have immediate access to local data. Moreover, they are often perceived by the public as the source of any and all types of atmospheric information, and they receive numerous climate information requests. While the offices conscientiously attempt to satisfy these requests, their main function is the production and dissemination of up-to-the-minute weather information, forecasts and warnings. They generally have severe manpower constraints and little time to organize a climate information base. Hence they frequently refer requests to the State Climatologist. However, it is desirable that the regional program provide to the National Weather Service Offices the local information they need to answer their most common requests.

Playing a similar role, but serving a more specialized clientele, are the **Agricultural Weather Offices** serving the region. Although their organizaton and scope varies from state to state, many of these offices work in close cooperation with federal and state agencies and with the state climatologists, making specialized measurements and creating and disseminating information tailored to agricultural needs. Indeed, in some cases well developed climate information production and distribution systems exist which have the potential to play a major role in any regional climate program effort. While this state-level role is best developed for agriculture, similar systems exist in some states for other areas where climatic information is important. Thus some **state air quality** and **water resources agencies** must be included as both users and producers of climate information.

Also in the category of users and producers are **research personnel** in universities, government laboratories and private institutes. While some of these may be involved specifically with climate, others will be in allied fields such as agriculture or water resources where climate information is required. Some research efforts may be specifically directed to the production of information useful in the sense discussed so far, others may require that information as their starting point. However, out of all of these efforts may come new observations, new understanding of atmospheric processes, new analysis techniques, or new ways in which users can be better served. Hence this group must be regarded as a vital part of the information creation process, and research efforts investigating all aspects of climate should be stimulated.

The **private meterological services** and **climatological consultants** are also producers and users. The major difference between these groups and those discussed so far is that the former are working for private clients, not producing information available to the general public. The majority of this group are the private meterological services, who provide routine information about current atmospheric situations. They commonly amalgamate historical climatological information, current observations, and weather forecasts to develop the information necessary for the operational decisions of the client. A much smaller private sector group are the climatological consultants, who specialize in analysis of the record of past observations to meet the often highly specific needs of a particular client. Both groups may use data collected specifically for the client, but they have frequent recourse to data held by the National Climatic Data Center, the Climate Analysis Center, or the State Climatologists. They may in turn provide information to these groups. The regional climate program must explore ways in which private and public sector producers of climate information can work for mutual benefit.

Taken together, these various groups provide a great range of information and serve a variety of functions. The full value of their products, however, can only be realized if all products are readily available in an understandable form to the ultimate user. At present that is by no means always the case. Each group has links with its own particular end users, not the whole user community. In general, the group with the closest contacts with the whole range of users are the State Climatologists. They are not only in the best position to provide the information to the users, but also in a position to undertake any necessary interpretation of the information, encouraging wise use and preventing unintentional misuse. In order to undertake this function, the State Climatologists must develop and strengthen links to all of the producer groups as well as maintain contact with the users. For an individual State Climate Program there are practical barriers to a direct implementation of this. These include time constraints for program personnel, limits imposed by individual interests and abilities, and financial constraints placed on the purchase of the necessary data communications and processing equipment. Indeed, it seems likely that duplicate facilities in each state in a region with similar climate conditions and user needs is inappropriate. Rather, the establishment of such facilities at the regional climate center, for the benefit of the Regional Climate Program as a whole, is most appropriate.

Thus, there are opportunities for the Southeast Regional Climate Program to **enhance the production of climate information.** In particular:

The production and delivery of climate information to the users in the Southeast United States can be enhanced by:
(a) establishing the Southeast Regional Climate Center as the focal point where the information products currently available from various national and local sources are readily and routinely accessible, and

(b) fostering, through the Regional Program and its Center, the analysis of the available information into forms suitable to meet user needs in the individual states and the region as a whole.

A number of logical steps must be, and can be, taken to implement this activity (Table II).

Table II: Steps necessary to develop the Southeast Region Climate Program to complement and enhance existing climate information delivery systems.

—develop and maintain close links with the National Climatic Data Center to ensure a free interchange of data and information products,
—strengthen existing state climate programs through the provision and interchange of climate information,
—increase the availability of Climate Analysis Center products in the region and foster their appropriate use,
—ensure National Weather Service Offices have adequate access to climate information to meet their needs,
—investigate ways existing communications networks for collection and dissemination of information may be utilized,
—stimulate research efforts of potential benefit to the user community,
—explore ways in which climate information producers in the public and private sectors can interact for their mutual benefit.

Users and Their Requests

The second step in assessing user needs is to determine the number and type of requests currently made to the information producers. Records of user requests were therefore obtained from each producer group active in the Southeast Region. The types of records available depends on the nature of the dissemination methods used by the various producer groups (Table III). Although actual numbers must frequently be estimated, this Table indicates the tremendous demand for information during a single year. It is obviously impossible to estimate the actual number of users of information disseminated over radio and TV. For routine publications the annual total circulation provides a crude estimate of user demand. Since in most cases there is a subscription charge for these publications, it is reasonable to assume that they are "useful," but it is not possible to suggest how they are used, how useful they are, nor how many people see and use a particular copy. The most detailed information on users and their requests, therefore, must come from the records on individual requests maintained by the National Climatic Data Center and by the individual State Climatologists.

Snow and ice storms are an annual hazard to coastal and piedmont areas, while at the same time provide a boost to the economy of mountain communities. Knowledge of the seasonal and intra-seasonal variation in snow and ice events has become an integral part of state and local snow removal plans. Climatological data is also a valuable tool used by local developers in site selection for ski resorts and by architects designing structures.

TABLE III: Estimates of the number of different users requesting climate information in the southeast United States in 1987. Numbers are derived from the total number of contacts between producers and users, corrected for multiple requests by a single user.

Producer Group	Dissemination Method	Request Records Available	Estimated number of users per year in Southeast
National Climatic Data Center	Publications	Circulation figures	10,000
	Individual mail/phone/walk in	Detailed records	14,000
State Climatologist	Publications	Circulation figures	5,000
	Individual mail/phone/walk in	Detailed records	6,000
Climate Analysis Center	Publications	Circulation figures	1,000
	Dial-in computer	Computer access records	200
Agricultural Weather Offices	County Agents	N/A	N/A*
	Radio/TV	N/A	N/A*
	Publications	Circulation figures	4,000
	Dial-in facilities	Access records	500
National Weather Service Offices	NOAA weather radio	N/A	N/A
	Individual mail/phone/walk in	Not recorded	?
Research Personnel	No formal "user service"	N/A	N/A
Consultants	For specific clients	N/A	N/A

* See Table V.

These records were analyzed for 1987 to determine the number and type of information requests made. The total number of requests, divided into 9 major user classes, is shown in Figure 2. Probably the most outstanding feature is the sheer number of requests. **During 1987 more than 19,000 requests for climate information were made by the citizens and institutions of the Southeast United States.** The range of their requests was widely variable (Table IV).

It is notable that during 1987 over 2,000 requests for information came from government agencies—federal, state and local. Since all of the programs considered here are to some extent government supported, this indicates the primary role they play in servicing their own funding agencies, over and above any service they provide to the wider community.

A particularly striking feature about Figure 2 is the relatively small number of requests from the agricultural sector, which is highly climate sensitive and where climate information is vital. The Agricultural Weather Offices commonly provide this information. A single contact between an Office and the National Climatic Data Center or the State Climatologist may provide the re-

quired climate information, which is then amalgamated with other agricultural information and disseminated to many agriculturalists. As an example, a recent survey by the North Carolina Agricultural Weather Program, which uses this process, suggested that at least half of the farmers in the area used atmospheric information on a routine basis (Table V). Indeed, given the high level of user satisfaction with this particular program and similar ones in other states, the Regional Climate Program must examine carefully the strategies they have adopted for the identification of user needs and the development and dissemination of information.

TABLE IV: Typical types of users and requests answered by the National Climate Data Center and the State Climatologists.

- Senior management requiring information prior to making decisions concerning investments for the design and location of new facilities,
- Government officials seeking information necessary for the formulation of public policies,
- Engineers assessing the effectiveness of their energy conservation measures,
- Lawyers needing reliable information in order to serve their client's interests,
- Media representatives needing unbiased facts for news stories and feature productions,
- School children requiring information for homework assignments, and science fair projects,
- University researchers addressing problems of climate change,
- The general public making an infinite number of decisions ranging from choosing a retirement or vacation home to choosing suitable plants for their garden.

TABLE V: Results of the assessment of the users of the services of the North Carolina Agricultural Weather Program.*

Number of initial contacts: 500
Number of responses received: 250

Percent familiar with NC Ag Weather Program: 63%

Of those familiar with program:

Frequency of use:	68% use it greater than once per day
	21% use it 1 to 4 times each week
Value of information:	85% useful/very useful
	13% somewhat useful
Source of information:	64% NOAA Weather Radio
	59% commercial TV
	27% commercial radio
	14% dial-in recorded telephone message
	(total > 100% because of multiple use)

* Information courtesy of Mr. Greg Johnson, North Carolina Agricultural Weather Program, North Carolina State University, Raleigh, NC.

The agricultural sector is only one instance where a single contact is made but numerous users are served. All of the other producer groups considered above have the same characteristic. Many other organizations and individuals, such as professional societies, public relations firms, and media representatives, obtain information and in turn become information sources for their members and clients. An outstanding example of this is the "Handbook" published by the American Society of Heating, Refrigeration and Air-Conditioning Engineers, which contains the climate information very widely used by engineers and architects for the design and construction of buildings and their heating systems. Indeed, much climate information, originally obtained from National Climatic Data Center or the State Climatologists, is incorporated into State Building Codes and routinely used every day throughout the region. Uses of this type are indicated in Table VI. Here it is impossible to determine the amount of use these receive, but certainly **the numbers presented in Figure 2 only represent the tip of the iceberg** as far as the total use of climate information is concerned.

Variation in seasonal weather patterns affects agriculture more than any other major economic enterprise in the Southeast. Late season freezes, record cold and heat, and extended drought periods have caused substantial losses to producers across the region during the 1980's. Farmers are now relying more on climatological data summaries to help plan cropping and marketing strategies. Historical climate information is an essential part of the technique used to forecast crop yields and the resulting long-term economic impact on agriculture.

TABLE VI: Alternative sources of climate information.

General Information	Specialized Information
Chambers of Commerce	Cooperative Extension Service
Public Libraries	Private Consultants
The Media	Industry Specific Documents
Commercial Publications	e.g., ASHRAE Handbook
Universities	State Building Codes
	Solar Energy Manuals

While Figure 2 indicates the demand for information over the region as a whole, there are significant differences in demand when the requests to the individual state climatologists are considered (Figure 3). First, the absolute level of activity differs from state to state. This reflects primarily the current availability of resources and personnel in each state since there is no reason to suspect that the demand for information varies widely across the region. Second, there are variations among states in the categories of users requesting information. These variations occur for a number of reasons. The number of potential users in any category may vary from state to state, the level of service to a particular category depends on the resources available to, and the particular expertise of, the individual state climatologist, while the level of awareness of the availability of services within each category may differ among states.

Even with these variations, however, the differences strongly suggest that **not all needs are being met.** It is difficult to imagine, for example, that it is only in South Carolina that there are a significant number of legal problems involving climate. In the other states there may be an unmet need for services to the legal profession. Indeed, there would seem to be opportunities throughout the region to increase the level of service and provide beneficial information. This must be addressed by any regional climate program.

The opportunities for development within the regional program must also take into account the different roles played by the National Climatic Data Center and the states. Although the objective of both groups is the provision of climate information, the role they play, through the type of information they commonly deliver, is very different (Figure 4).

In general, the majority of requests to the National Climatic Data Center and to the states are for atmospheric data rather than information. Most of these requests are for data in hard-copy form. However, the National Climatic Data Center responds to a significant number of requests for magnetic tapes containing large datasets, whereas the states answer few such requests. Hence the National Climatic Data Center plays a distinctive role as the source of these large datasets.

The types of requests for hard copies of data also differ between the two sources. The National Climatic Data Center provides primarily the official observational record, with the states providing a somewhat wider range of material. Most of the requests to the states are met using data provided initially from the National Climatic Data Center but a significant number must be met from other sources. Some requests are for locally collected data, others are for up-to-the-minute information developed by the Climate Analysis Center while yet others are for the preliminary

climatic data received directly from the National Weather Service, data which will eventually be quality controlled, archived and made available as the official climate record by the National Climatic Data Center. Hence the states' "raw" information contains a significantly different mix from that requested from the National Climatic Data Center.

The provision of data summaries of various kinds are a larger portion of the total requests for the states than for the National Climatic Data Center. Again, some of these are summaries which have been developed by the National Climatic Data Center directly and made available through the State Climatologists. Others have been developed by the individual state climatologists, often using data provided by National Climatic Data Center. Whichever the case, however, the high demand at the state level implies that the requests to the State Climatologists are much more for information about climatic conditions than for simple data tabulations.

This suggestion is reinforced by the difference between the National Climatic Data Center and the states in the percentage of requests for informational publications. Again, while the National Climatic Data Center disseminates only its own publications, the states make available these publications and others which are produced locally. The latter are commonly tailored to the needs of the particular state and one sector of its economy. Many have been specially produced by the State Climatologist, but equally important in several cases are publications derived from research efforts which themselves may not have been specifically tailored to user needs. The actual demand for all types of publications indicated in Figure 4, however, represents only new requests made during 1987. The publications may have been available for several years, so the current demand is certainly not the total demand, and again may represent only a small fraction of their actual use. Furthermore, the regular data publications issued by the National Climatic Data Center, and the informational newsletters issued by some states, indicated in Table III, which go to a well-established mailing list, are not included here.

It is apparent from this analysis that the states of the Southeast Region have developed a clear role and are meeting a clear need. This role is very different from that of the National Climatic Data Center although the missions, and thus the roles, overlap somewhat. At the same time, the level of service to various sectors of the community vary from state to state and it is reasonable to assume that some user groups in all states could benefit from better service. Thus the Southeast Regional Climate Program must include two functions which arise directly from the present situation:

1. Explore and encourage increases in the level of service to the various sectors in each state which currently are not being well served, including encouragement of the use of the information through education and example, and
2. Develop methods of enhancing the role of the southeast program, in cooperation with all climate information producers, as a complement to the National Climatic Data Center, by emphasizing the production of required data summaries and informational products.

Assessment of User Needs

The previous section indicated the types of users of climate services and the level of their demand. The next step is to determine how these users view the utility of the services being provided, what their true needs are, and how they can best be met. Such a determination was undertaken by the State Climatologists. They reviewed their own files and those of the National Climatic Data Center for user comments which addressed these questions. They also, where appropriate, discussed real needs with those requesting information and contacted previous users

and personal acquaintances for discussions. Thus a wide variety of users and potential users were involved in many discussions.

Some of the quantitative information obtained from these discussions, based on approximately 300 contacts, is presented in Figure 5. Many users regarded the climate information as vital to their job. Others found varying degrees of usefulness, while others obtained the information for personal interest or for occasional job-related tasks. In all of these groups, but especially in the last, many requests were made on an irregular basis. Most people who regard the information as highly important require it on a routine basis. While daily, weekly and annual requests are approximately equal, a monthly demand is dominant. This may in part be a response of the knowledgeable user to the predominance of monthly publications from the various producer groups, rather than an actual need on a monthly basis. Nevertheless, the majority of users obviously believe that their needs are being met most of the time, and relatively few are completely unsatisfied with the current situation.

In addition to the quantitative analysis, the comments made by users during the various discussions provided insight into their needs for and outlook on climate information and services. Whatever their specific field of involvement, their outlook is colored by their level of climatological expertise, their knowledge of actual and potentially available climate information, their occupations, the value placed on the information, and previous experience with climate services.

In assessing user needs in a form useful for developing a responsive climate program, therefore, it is most appropriate to consider services in the light of the current outlook of the users as inferred from their responses to these discussions. From these discussions, indeed, a classification of users can be inferred (Table VII). This is intended to provide a framework upon which to build a climate program which is responsive to user needs and which stimulates the users to demand the best, most appropriate, information they need. Thus the six categories of Table VII are not mutually exclusive, and they cut across all economic sectors. The classification is dynamic, with users moving upwards through categories as their knowledge and needs become more sophisticated. The individual categories are discussed below.

Sophisticated Users

These are commonly users with a high degree of training in a scientific or engineering discipline, often working for a major company and involved in operational decision making. Commonly, a private weather service provides much of the current atmospheric information they need.

Many of these people, however, are in mid-management technical positions, and are seen by top management as "atmospheric experts." Hence, with the rising concern about climatic change they are being asked to become involved in long-term strategic planning. They are commonly uncomfortable with that role. While they are familiar with climatic data and its availability, they also know of the potential pitfalls in its use, but are not experts in the subject. Similarly, they know something about climatic change itself, but claim no expertise in the subject. Hence they have a need for **analyses of past climate in a form suitable for strategic decision-making** together with **projections of future climate conditions** and in most cases, some general **information about climate and climatic change.**

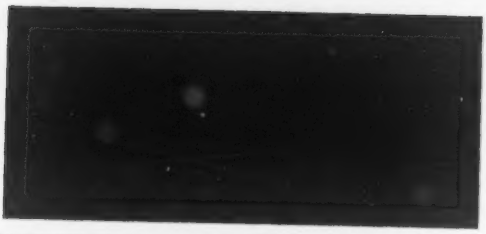


TABLE VII: The basic categories of users of climate services, based on types of needs and responses.

Sophisticated Users
Routine Users
Personal Interest Users
Frustrated Users
Potential Users
Informed non-users

Routine Users

These are users without specific climatological training but who have found, by various means, that the use of climatological information helps them perform their tasks more effectively. The information is usually used for a very specific purpose. This use may be regular, such as an assessment of last month's climate as an aid to the analysis of the efficiency of building energy use, or occasional, as with the request for data for a particular legal purpose. Many of these requests are for **past climate data.** There are also some requests for **current atmospheric information.** For the latter, requests are usually from people in companies which are not big enough or the information perceived as not important enough to warrant investment in private weather forecasting services, but who need more than is routinely provided by the National Weather Service forecasts.

These users are generally satisfied with the current data, information and services. However, their climatological knowledge is limited and they may not be making the best use of the information available, or using the best available information. They have developed their own strategy, and are not in a position to take time to keep abreast of developments in climatology. Hence they, and their companies, would benefit from continuing information about developments in climate and climatology.

Personal Interest Users

These are people who make requests primarily because they are interested in what is going on in the atmosphere. The information requested may or may not be job related. A very wide range is covered here, from explaining why some sites are better for certain vegetation types than others through settling friendly disputes about the biggest snowfall ever in the local area to assisting in vacation planning. The request may be for a very specific purpose, so that after a conversation with the climatologist refining the needs and balancing them with the data available, the needs can be met. Often the request is "Send me all you have about . . ." Again, refinement of the needs can usually lead to the provision of the needed information.

Most of the needs of this group can be summarized as needs for **past climate records.** However, in discussing the needs, there is an educational role in providing **information about climate and climatic change.**

This group as a whole is satisfied with the service currently provided. Indeed, most are delighted that someone can, and is willing to take the time to, provide assistance.

Frustrated Users

People in this group have no climatological background but have come across an example of the use of climate information which they believe could help them. They want to follow up and use it themselves. Some are successful in their quest and become routine users, others are much less successful and become frustrated. One source of frustration may stem from not knowing where to go or who to ask, or receiving no help from a logical source. Certainly no climate program should leave people frustrated because of lack of help available, and fortunately such people appear to be very few in number.

A more significant source of frustration, however, is finding that the required information is simply not available or is too expensive, or that the available data need extensive processing before being useful. While a clear statement of what is and what is not possible with the current available data should relieve feelings of frustration, these people are obviously potential users, and their needs should be carefully assessed. Many require **current atmospheric information** or **analyses of past climate in a form suitable for decision-making,** the types of information which an individual state program may not be able to provide but which could be developed by a regional climate program.

Potential Users

The potential users are those people in fields of activity where others successfully use climate information or those in fields where none is currently used but where they could be pioneers in its use. In all cases these users have no climatological training and need help.

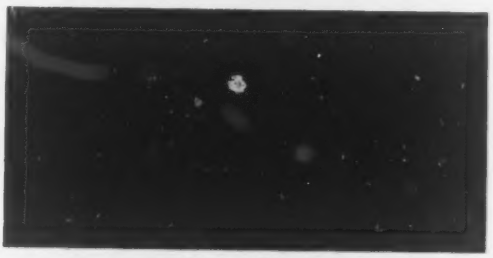
In the normal operation of the state climate programs, these people are rarely considered. The programs operate essentially in a response mode, fielding questions from those who already have a need, not actively seeking to help others who might benefit. However, there are probably a large number of potential users who, with a little help and encouragement, could become major users and benefit from the use of the information. An active program should seek to provide such help and encouragement.

Here, as with the case of frustrated users, individual state programs may not be in a position to undertake this active role, but a regional program has the opportunity to provide information needed to help these potential users.

Informed Non-Users of Climate Services

This is the group which has some use for climate information but whose needs are such that they can usually be met from secondary sources. In most cases they have already explored the potential for using the available climate services, know what is available and have become knowledgeable about the possibilities of using it. However, they find that it is of no help to them. Usually this implies that climate plays some role in the activities they are concerned with, but that once the mean conditions have been taken into account, climate variations and fluctuations are insignificant variables compared with others with which they have to deal.

Although the present climate services may be of no help, an active program should keep this group informed of developments in the understanding of climate processes and in analysis techniques. This group represents potential users in the future.



Met and Unmet Needs

Having reviewed in previous sections the needs of users, the current levels of service and the current producers of information, it remains to synthesize the results to consider the met and un-

met needs, and thus indicate the potential role of a Regional Climate Program in the Southeast United States.

The most convenient way to approach this synthesis is through consideration of the basic information needs highlighted in the previous section, how well these needs are currently met, and the potential for improving the service (Table VIII).

TABLE VIII: The major areas of user needs, the current level of service, and the opportunities for meeting the needs.

Past Climate Records
- Many needs currently met
- Some improvement in service possible

Analyses of past climate in decision-making form
- Some needs currently met
- A wider range of users could be assisted

Current atmospheric information
- Needs are poorly met
- Potential to provide service exists

Projections of future climatic conditions
- Available information not widely disseminated
- Information delivery system can be developed

Information about climate and climatic change
- Needs partly met in some states
- Ability to provide much better information exists

Past Climate Records

The term "past climate records" refers to quality-controlled observational data, together with simple derived information such as monthly averages, long-term normals, and state-wide averages. This, in fact, constitutes the bulk of the information emanating from the National Climatic Data Center, and the basis for many of the services provided by the State Climatologists. The bulk of the 19,000 annual requests are for this type of information, indicating that there is a real need which is already being met here. The many users indicating at least partial satisfaction during the discussions suggests that this need is being met successfully.

Nevertheless, the discussions also indicated that improvements are possible. Indeed, it is in this area where the potential for movement up through the categories of Table VII is most apparent. Closer interaction with users could lead to the provision of more appropriate data for their particular needs. This may require that users be informed of, and have access to, different types of

observations and newly developed analyses which are more useful to them. Such interactions can also reveal the needs of the user for analyses of particular types, which leads directly to the next area of need.

Analysis of past climate in form suitable for decision-making

Analyses here refer to the use of past information to assist the decision-maker looking into the **future.** They may involve the likely frequency of an event, the probability of it occurring in a given time period, or the highest values in the last 10 years. Many such analyses have been produced by the National Climatic Data Center and by individual State Climate Programs. Their real usefulness is difficult to assess since once the user has the product there is no further need for contact with the producer, who then has no idea whether it is used every day, every year, or never. User comments, however, suggest that these products are vital. Indeed, there is a clearly expressed need for more analyses directed to decision making. While users themselves may, of course, take the original data and produce their own information, most analyses must be undertaken in a research mode. Issues of data quality, spatial and temporal variability and resolution, and appropriate statistical manipulation must be addressed. Most users have neither the time nor the experience to undertake these tasks. Here the climatologist must take the lead.

There is thus an unmet need in this area. The range of analyses desired by users was very wide. Many of the suggestions could be implemented after suitable research. However, a clear agenda must be set for the development of such products which can only be obtained from 'quality' climate data. (See Appendix 2).

Current Atmospheric Information

Under this heading the frequently expressed needs are for reliable data for the immediate past (usually during the preceding month) and for information linking conditions in the past few months, the normal climate and the current and forecast weather. It is often difficult with the current information system to get data for the recent past. For those for whom it is vital, recourse often has to be made to listening to the daily weather report, hoping that "yesterday's weather" is given, and writing it down. Using more official channels, the observational record is sent to the local weather service forecast office and eventually transmitted to the National Climatic Data Center. Here the data has to be checked to ensure that it is of high quality and then published. This process currently takes several months. The state climatologists provide a "stop-gap" service. They receive a copy of the record from the local National Weather Service Office when it is sent to the National Climatic Data Center. They use this, relying on their judgement and experience to check for errors, to provide some early information. Thus needs are met, but at present in a very unsatisfactory fashion.

The linking of recent conditions, climatologically normal conditions, and weather forecasts is often of vital concern in operational decisions. Indeed, in one area of the nation, centered on Nebraska, these links are so vital for irrigation scheduling that a regional climate program has been developed to address this specific issue. Such a clear and overriding demand for this type of information has not been demonstrated for the Southeast United States. For the majority of those in the area for whom this type of information is vital the needs are met by the private sector. For others, the prime need is for data of the recent past, which they themselves can combine with the normal climate and the weather forecast to create their own information product.

Projections of future climates

Until recently the only way to consider climatic conditions a few months or years ahead was to

use the past records as a guide. These records do not indicate when a particular event will occur, only that it has a certain probability of occurring in a given time period. Now climate forecasts, which do provide statements about when events are likely to occur, are becoming available. Climate forecasting, however, is in its infancy. Long-range forecasting for periods up to a year ahead is in the experimental stage, while monthly and seasonal temperature and precipitation "outlooks" are produced routinely by the Climate Analysis Center. The term "outlook" is used advisedly, to warn that these are general projections which do not have the same accuracy as the daily weather forecasts. However, it can be anticipated that these outlooks will become more reliable, refined and useful. Already a start is being made in producing more directly useful information by combining the forecasts with past data to provide projections of the number of heating degree days likely for specific regions for the specific forecast period. This type of information is likely to expand in the future.

Most users of climate information are only sketchily aware of the availability of these outlooks. The major source of information, the media, commonly provide a summary of predicted conditions too short to be of much use for any application, and pass over the more detailed information which is available. Although most informed users regard the present accuracy of these outlooks as insufficient for routine use, they have the potential to meet a variety of needs. In this case the climate program must keep abreast of developments and keep potential users aware of their increasing potential.

The coastal zone is the common link between states in the Southeast and is the most valuable economic resource. Rapid development and population growth continues to strain the limited natural resources along this zone. Beaches and coastal wetlands have become more vulnerable to normal climate fluctuations due to this increased pressure. Climatic data is being used by local, state, and federal agencies to characterize the impact on our coastal and marine resources.

Information about climate and climate change

Virtually everyone is aware of "climatic change," and many users of climatic information are keen to find out what it might mean to them, fearing that it may lead to adverse consequences. However, the role that climate change may play in the future activities of the Southeast United States is completely unclear, even to the practicing climatologist. This is a research frontier. Probably all the climate service program can do at the moment is to provide information about the current state of knowledge, including emphasis on the current state of uncertainty. At the same time, discussion with users about their concerns, particularly where their operations are most sensitive to climate, should provide the kind of information needed if realistic assessments of potential impacts of climate change are to be made.

In this area, therefore, there is a major unmet need, not for a specific piece of information of immediate practical benefit, but for information about climate in general and climatic change in particular, information which may provide a much greater long term benefit to the region and the nation.

Meeting the Needs

The previous sections have indicated the needs of the users of climate information in the Southeast United States and considered whether these needs are currently met or not. In many cases there is more than adequate service. In other cases additional needs can be met rather easily following consultations between the users and the producers. In other areas some applied research is needed, while in still others an educational mission is apparent. Further, there must be consideration of the role of the private sector consultants working in harmony with public sector efforts.

In addition to the needs themselves, analysis of the currently available sources of climate information, and the ways in which they are currently used, has led to the conclusion that the Southeast Regional Climate Program, properly constituted, has a vital role as an integral part of the regional and national climate information delivery system.

Thus, in order to develop a Southeast Regional Climate Program which is responsive to user needs and contributes to the delivery of climate information for the benefit of the region and the nation, the following recommendations are made:

- **Develop guidelines for, and establish an effective and efficient climate information delivery system for the Southeast United States.**

This recommendation addresses the key task of a Southeast Regional Climate Program in making pertinent information available to those who need it. An information delivery system involves the collection of information from the various producer groups, its synthesis to enhance the value to the local users, and its dissemination to those users. Thus the system must involve federal, state, and local government bodies, the research community, the private sector and climate information users. Development of methods of coordination and cooperation between them is needed to ensure the establishment of a system which provides information without undue duplication of effort and waste of resources. The system, in addition to providing the basis for the information available for the whole program, must also provide the facilities required to address some of the other recommendations for the program, as discussed below.

The rapid improvement in electronic data interchange technology indicates that the information

delivery system should be electronically based. Computer-to-computer communications between the information producers and the Regional Center must be developed, and efforts must be made to initiate electronic communications between the Center and the individual states. Suitable on-line storage and analysis capabilities must be available at the Regional and State Centers, and suitably equipped users must have ready access to the system. At the same time, however, the traditional methods of information dissemination, by answering specific individual requests or through publications containing data tabulations and analyses and educational articles, must be considered.

- **Establish and maintain close links with the user community, to ensure that high quality and useful data and information products are developed and provided.**

The most efficient information delivery system is useless if the information produced is not needed. In order to ensure that useful products are provided, representatives of user groups must be involved at all stages of system planning and information development. Thus, this effort is essentially one of establishing and maintaining mechanisms whereby users and producers can interact, both on a routine basis to ensure that the Program continues to be responsive to user needs and also on an ad hoc basis, so that the Program can respond rapidly when special circumstances warrant special actions.

- **Encourage continued development and strengthening of the individual State Climate Programs in the region.**

The State Climatologist provides the climate service in each state. While the level of activity varies between states, in all of them the State Climate Program can be enhanced and better service provided. The Regional Program must explore ways to foster the development of the state programs. The regional climate information delivery system is likely to play a key role in this. Other opportunities include encouragement of states to share experiences and expertise, so that the strengths of each individual program can be utilized in all others, thus contributing to an overall strengthening of all state programs as well as the regional one.

- **Establish priorities for the development of information products, based on past climate records, which are useful to decision-makers.**

Analyses of the past climate record in forms which aid decision-makers must be identified. Such analyses, however, are often research projects which require a significant investment of personnel and resources. Consequently, priorities for the development of such products must be established jointly by the users and producers, to ensure that the resources available are used for the maximum possible benefit.

- **Develop a system to ensure that the record of recent climate is readily accessible to all users, while emphasizing that data are preliminary and unverified.**

A major unmet need for many users is information about recent climate conditions. The Regional Climate Center must explore ways, and develop a system, which allows users ready access to this information. The system must make clear to the user that the information has not been quality controlled, may contain errors, and thus is a preliminary record of the past climate. This "near real time" system must be developed as an integral part of the overall information delivery system.

- **Explore the potential uses of the currently available climatic forecasts and their associated products.**

Although climate forecasting is at present commonly regarded as insufficiently accurate for routine use, knowledge and skill are increasing rapidly and potential practical applications of forecasts are being developed. The Regional Program should begin now to investigate ways in which such information could be beneficial to users. This exploration must be undertaken in cooperation with the Climate Analysis Center, other bodies providing forecasts, and the user community. Any climate information delivery system which is developed must be capable of incorporating these forecasts as their utility increases.

- **Establish methods for the dissemination of general information about climate and climate change, and for education about the appropriate use of climate information.**

Many users, and potential users, expressed a desire for information about climate in general, with major emphases on recent climate events and on climatic change and its potential effects on their business. Thus there is a need for general information about climate. In addition, a need was expressed for help and advice on how to use the available information wisely, so that there is also an educational mission. The Regional Program must explore methods of meeting these needs as an integral part of its role of ensuring that climate information is not only available but also used in appropriate ways for the benefit of the region and the nation. This is thus a key element of the climate information delivery system.

These recommendations for the development of the Regional Climate Program all build on the current availability of data and information and on the expertise already available in the region. They respond to the needs of users as articulated in the "User Needs Assessment" and provide the guidance necessary for the development of a Program which promotes the wise use of climate information, is responsive to user needs and is likely to provide significant benefit to the region and ultimately to the nation as a whole.

APPENDIX 1
THE SOUTHEAST REGION CLIMATE PROGRAM

THE SOUTHEAST REGION CLIMATE CENTER

John C. Purvis, Director (803) 737-0800
David J. Smith, Regional Climatologist
South Carolina Water Resources Commission
1201 Main Street, Suite 1100
Columbia, South Carolina 29201

STATE CLIMATOLOGISTS OF THE SOUTHEAST REGION

ALABAMA

Richard McNider (205) 895-6257
K.E. Johnson Center
University of Alabama, Huntsville
Huntsville, Alabama 35899

FLORIDA

Thomas Gleeson (904) 644-3417
Department of Meteorology
Florida State University
Tallahassee, Florida 32306

GEORGIA

Gayther Plummer (404) 542-1555
Institute for Natural Resources
Ecology Building
University of Georgia
Athens, Georgia 30602

NORTH CAROLINA

Jerry Davis (919) 737-3056
Department of Marine, Earth and Atmospheric Sciences
Box 8208
North Carolina State University
Raleigh, North Carolina 27695-8208

SOUTH CAROLINA

John Purvis (803) 737-0811
South Carolina Water Resources Commission
1201 Main Street, Suite 1100
Columbia, South Carolina 29201

VIRGINIA

Patrick Michaels (804) 924-0549
Department of Environmental Sciences
Clark Hill
University of Virginia
Charlottesville, Virginia 22903

APPENDIX 2: List of the Historical Climate Station Network in the Southeastern United States

One of the major tasks of the Southeast Climate Program is to maintain a 'quality checked' database for impact assessment of long- and short-term climate variability and change. These stations represent only a portion of the climate observation sites in the Southeast.

Station Number	State	Location	Year Record Begins
011084	AL	BREWTON 3SSE	1890
011694	AL	CLANTON	1893
012813	AL	FAIRHOPE 2NE	1918
013511	AL	GREENSBORO	1855
013816	AL	HIGHLAND HOME	1892
017157	AL	ST BERNARD	1907
017304	AL	SCOTTSBORO	1882
017366	AL	SELMA	1858
018024	AL	TALLADEGA	1888
018178	AL	THOMASVILLE	1891
018323	AL	TROY	1872
018385	AL	TUSCALOOSA OLIVER DAM	1854
018438	AL	UNION SPRINGS 4S	1868
018469	AL	VALLEY HEAD	1885
080211	FL	APALACHICOLA WSO AP	1903
080228	FL	ARCADIA	1899
080478	FL	BARTOW	1887
082220	FL	DE FUNIAK SPRINGS	1896
082850	FL	EVERGLADES	1926
082915	FL	FEDERAL POINT	1892
082944	FL	FERNANDINA BEACH	1891
083163	FL	FORT LAUDERDALE	1912
083186	FL	FORT MYERS WSO AP	1891
083207	FL	FORT PIERCE	1852
084091	FL	HOMESTEAD EXP STN	1910
084289	FL	INVERNESS 3SE	1899
084570	FL	KEY WEST WBO AP	1832
084731	FL	LAKE CITY 2E	1857
085275	FL	MADISON 4N	1889
086414	FL	OCALA	1889
086997	FL	PENSACOLA FAA AP	1879
087851	FL	SAINT LEO	1890
088758	FL	TALLAHASSEE WSO AP	1885
088824	FL	TARPON SPRINGS	1884
088942	FL	TITUSVILLE	1901

090140	GA	ALBANY 3SE	1878
090586	GA	BAINBRIDGE INT PAPER CO.	1884
091340	GA	BRUNSWICK	1878
092318	GA	COVINGTON	1875
092475	GA	DAHLONEGA	1874
092966	GA	EASTMAN 1W	1882
093516	GA	FORT GAINES	1882
093621	GA	GAINESVILLE	1872
093754	GA	GLENNVILLE	1904
094170	GA	HAWKINSVILLE	1892
095874	GA	MILLEDGEVILE	1878
095882	GA	MILLEN 4N	1882
096335	GA	NEWNAN 4NE	1882
097276	GA	QUITMAN 2NW	1882
097600	GA	ROME	1855
097847	GA	SAVANNAH WSO AP	1836
098535	GA	TALBOTTON 1NE	1878
098703	GA	TIFTON EXP STN	1911
098740	GA	TOCCOA	1879
099141	GA	WARRENTON	1884
099157	GA	WASHINGTON 2ESE	1884
099186	GA	WAYCROSS 4NE	1882
099291	GA	WEST POINT	1882
310090	NC	ALBEMARLE	1911
310506	NC	BANNER ELK	1907
311677	NC	CHAPEL HILL 2W	1856
312635	NC	EDENTON	1896
312719	NC	ELIZABETH CITY	1911
313017	NC	FAYETTEVILLE	1871
313510	NC	GOLDSBORO 1SSW	1860
313897	NC	HATTERAS	1874
313969	NC	HENDERSON 2NNW	1893
313976	NC	HENDERSONVILLE 1NE	1890
314055	NC	HIGHLANDS	1878
314684	NC	KINSTON 5SE	1899
314938	NC	LENOIR	1871
315123	NC	LOUISBURG	1891
315177	NC	LUMBERTON 6NW	1882
315340	NC	MARION	1888
315356	NC	MARSHALL	1899
315771	NC	MONROE	1888
315830	NC	MOREHEAD CITY 2WNW	1896
315838	NC	MORGANTON	1889
315890	NC	MOUNT AIRY	1889
316044	NC	NASHVILLE	1904
317202	NC	REIDSVILLE 2NW	1901
317615	NC	SALISBURY	1882
317994	NC	SMITHFIELD	1889
318113	NC	SOUTHPORT 5N	1844
318292	NC	STATESVILLE 2NNE	1866

318500	NC	TARBORO 1S	1871
319147	NC	WAYNESVILLE 1E	1894
380074	SC	AIKEN 4NE	1854
380165	SC	ANDERSON	1884
380559	SC	BEAUFORT 7SW	1862
380764	SC	BLACKVILLE 3W	1884
381277	SC	CALHOUN FALLS	1892
381310	SC	CAMDEN 3W	1849
381549	SC	CHARLESTON	1785
381588	SC	CHERAW	1882
381770	SC	CLEMSON UNIVERSITY	1892
381944	SC	COLUMBIA U OF SC	1872
381997	SC	CONWAY	1888
382260	SC	DARLINGTON 1N	1895
383468	SC	GEORGETOWN 2E	1893
383747	SC	GREENVILLE-SPARTANBURG AP	1878
383754	SC	GREENWOOD 3NE	1884
384690	SC	KERSHAW	1916
384753	SC	KINGSTREE 1SE	1882
385017	SC	LAURENS	1901
385200	SC	LITTLE MOUNTAIN	1893
386209	SC	NEWBERRY	1887
386527	SC	ORANGEBURG 2	1916
387631	SC	SALUDA	1902
387722	SC	SANTUCK	1893
388426	SC	SUMMERVILLE	1898
388440	SC	SUMTER	1901
388887	SC	WALHALLA	1889
389327	SC	WINNSBORO	1887
389350	SC	WINTHROP COLLEGE	1900
389469	SC	YEMASSEE	1882
440766	VA	BLACKSBURG 3SE	1891
441209	VA	BURKES GARDEN	1896
441593	VA	CHARLOTTESVILLE	1849
441929	VA	COLUMBIA 2SSE	1898
442155	VA	CULPEPER	1907
442208	VA	DALE ENTERPRISE	1880
442245	VA	DANVILLE BRIDGE ST	1891
442941	VA	FARMVILLE 2N	1897
443192	VA	FREDERICKSBURG NATIONAL PARK	1893
444128	VA	HOT SPRINGS	1892
444876	VA	LEXINGTON	1861
444909	VA	LINCOLN	1901
446139	VA	NORFOLK WSO AP	1871
447338	VA	ROCKY MOUNT	1894
448062	VA	STAUNTON SEWAGE PLANT	1868
449151	VA	WILLIAMSBURG 2N	1900
449263	VA	WOODSTOCK 2NE	1889

Figure 1: The area of the Southeast Regional Climate Program, showing the Regional Center and the State Climatology Offices. *Produced by the SCWRC Cartographic Lab*

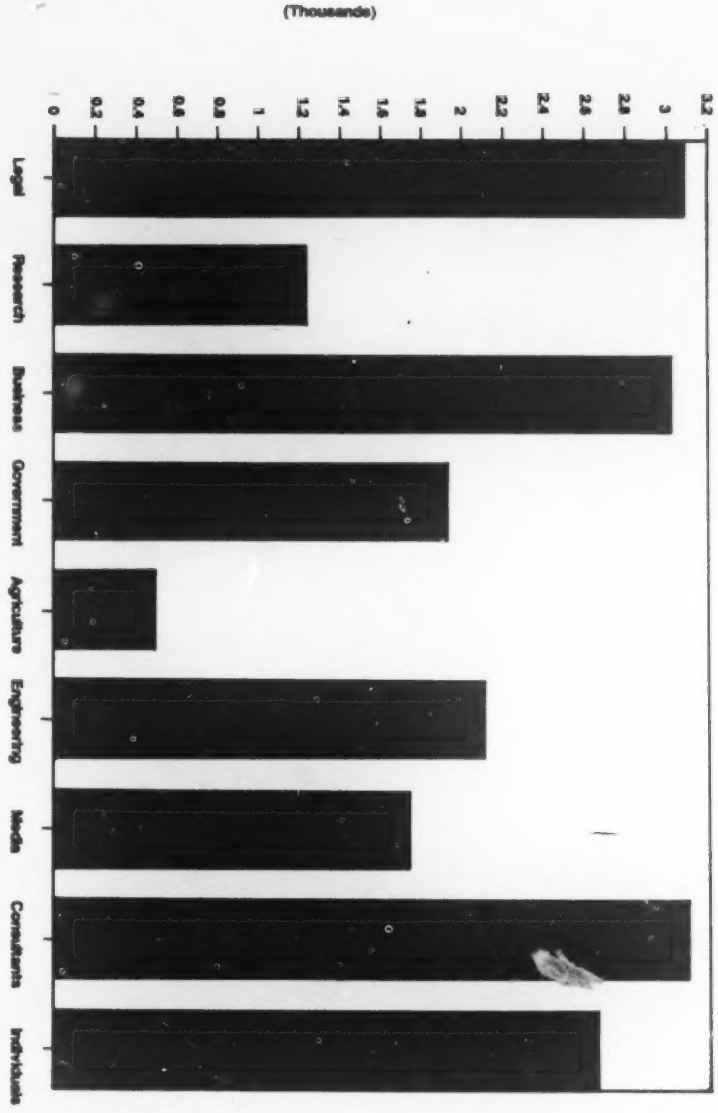


Figure 2: The number of users from the Southeast (by category) requesting information from the National Climatic Data Center and the various State Climatologists during 1987.

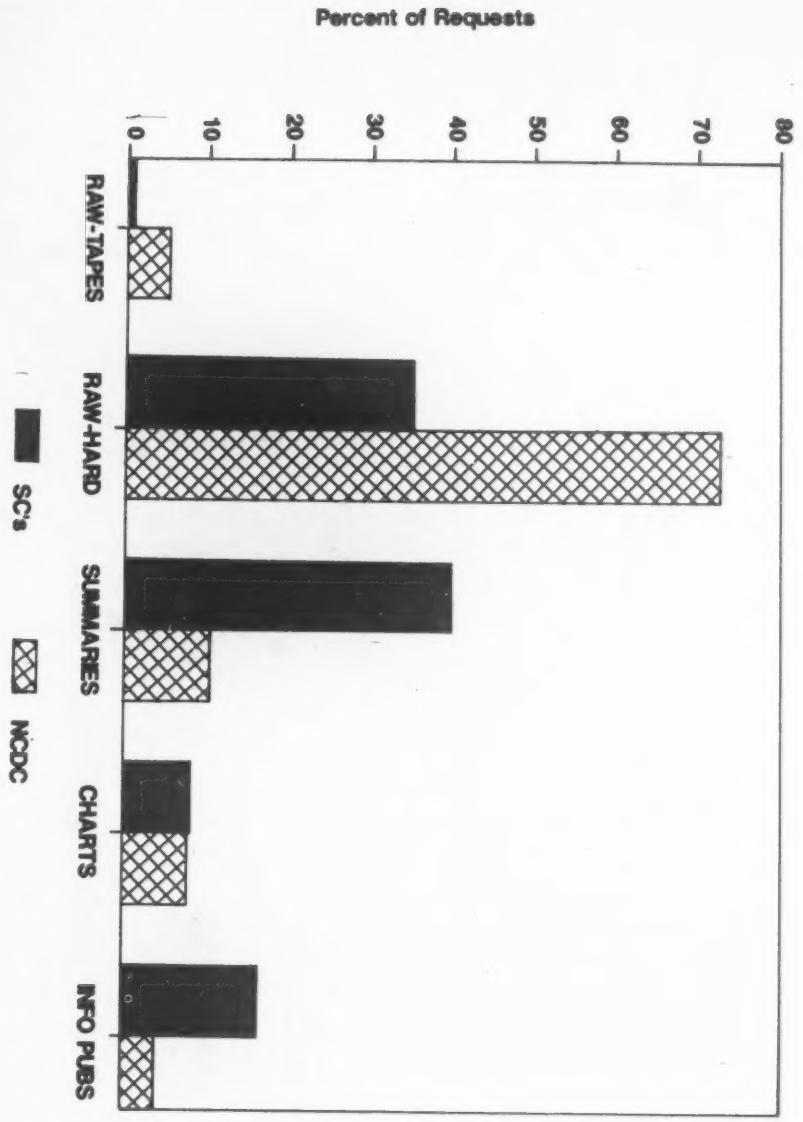


Figure 4: Types of information requested from the National Climatic Data Center (NCDC) and the State Climatologists (SC) in 1987.

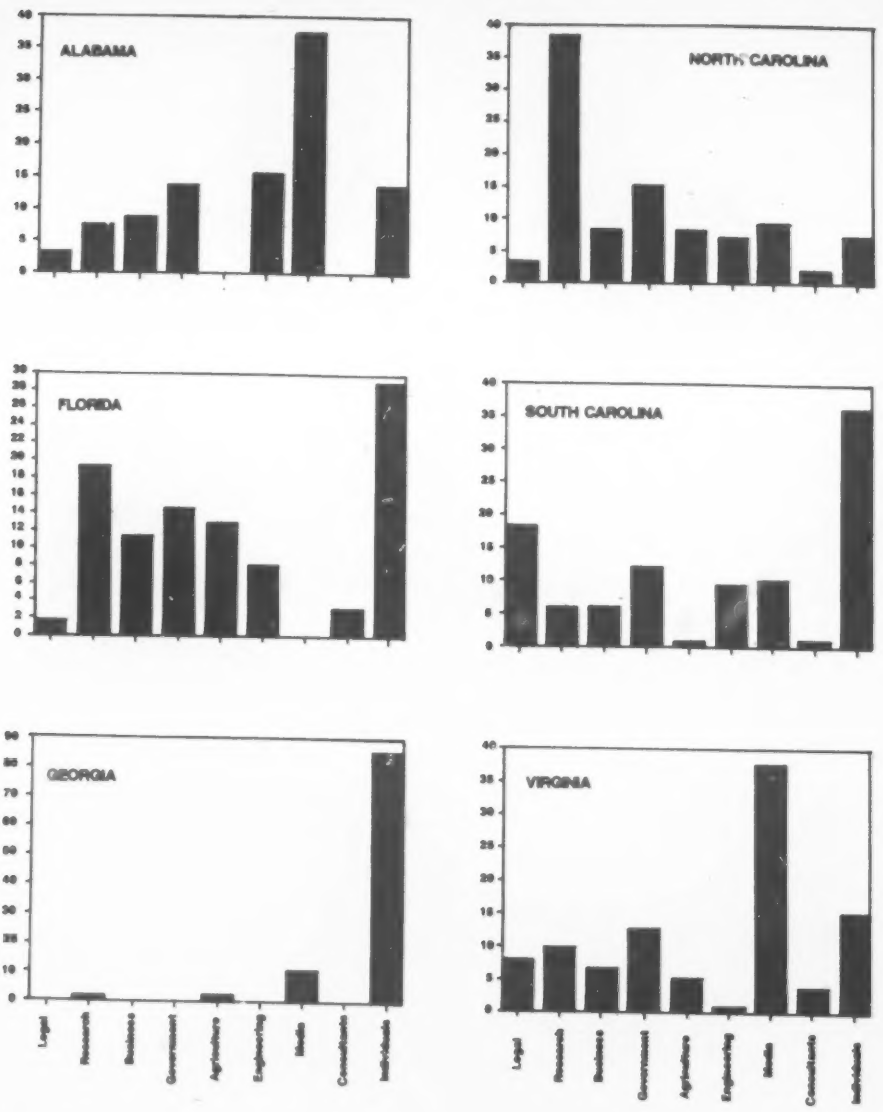


Figure 3: Percentage of users in each major use category for each state in 1987.

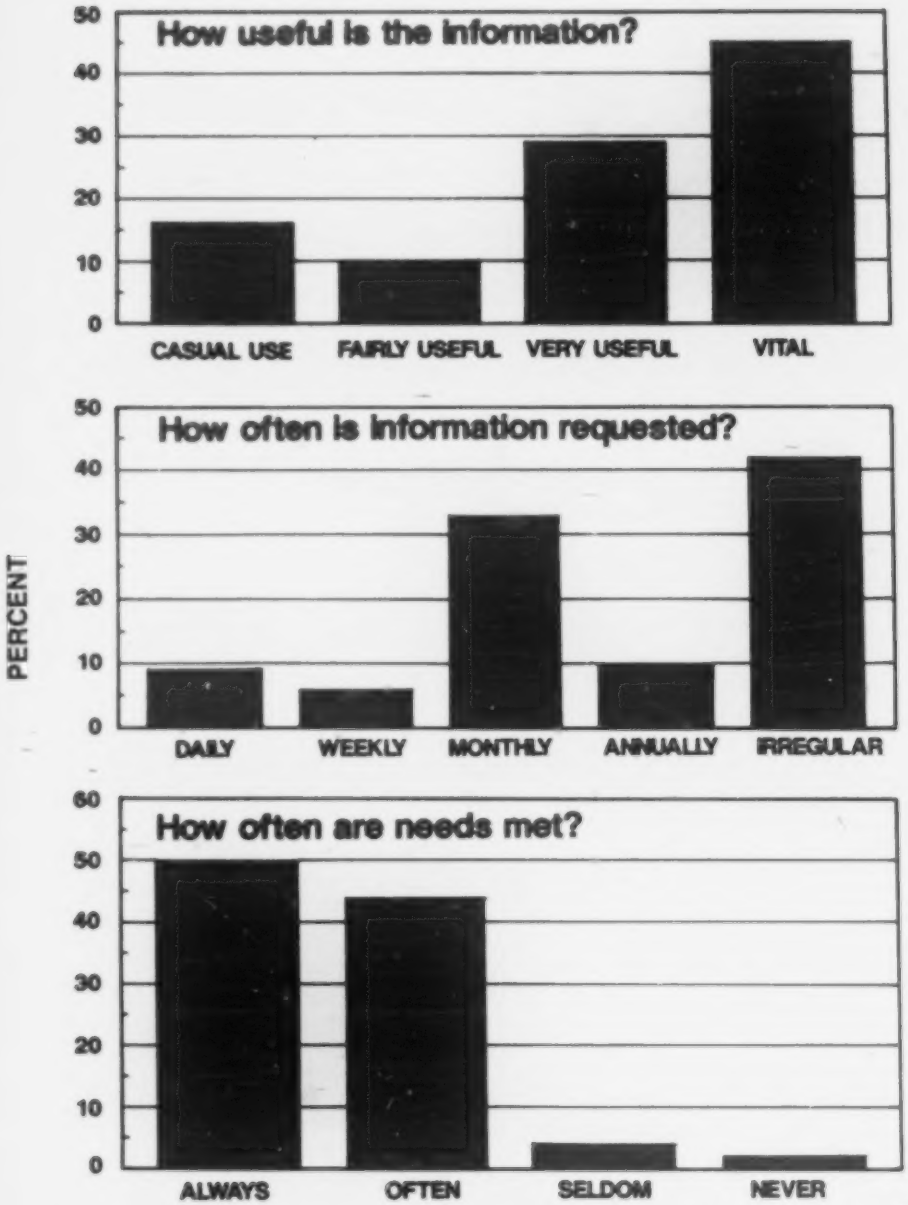
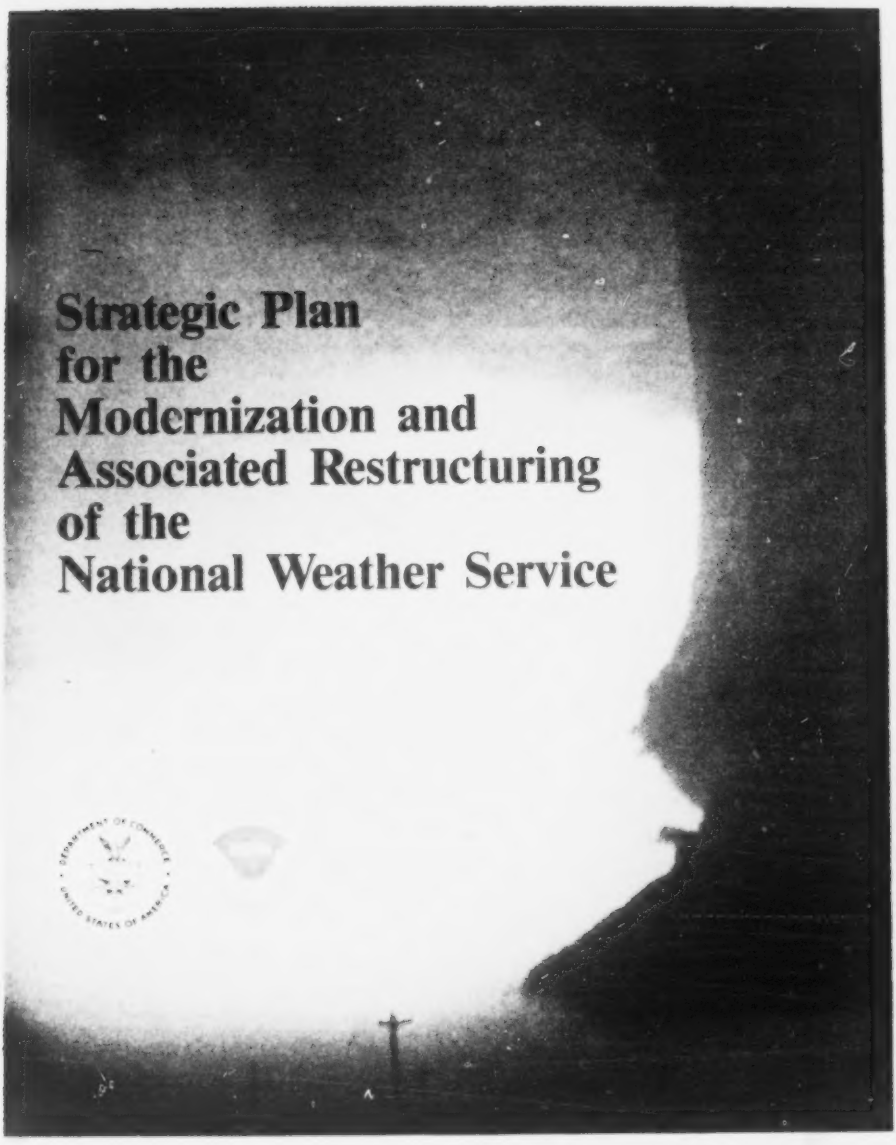


Figure 5: Indications of the value of climate information (top), the frequency with which information is requested (middle), and the current level of service (bottom). The information was obtained from discussions with approximately 300 people.

21-905 0 - 89 - 8


Strategic Plan
for the
Modernization and
Associated Restructuring
of the
National Weather Service

Cover photograph compliments of the National Center for Atmospheric Research Field Observing Facility

The right side of the photograph shows the main storm tower of a rotating thunderstorm near Limon, Colorado on June 12, 1984. The shelf cloud can be seen on the inflow side of the storm at the bottom left side of the tower. This thunderstorm later produced several tornados.

Table of Contents

Introduction ____ 1
Principles for the Modernization and Associated Restructuring ____ 2
The Need To Implement New Science and Technology ____ 3

The Technological Opportunity ____ 5
Major Technologies for Modernization ____ 5
The Need To Restructure ____ 8

The National Weather Service in the 1990s ____ 10
The Weather Forecast Office (WFO) Area of Responsibility ____ 10
Integrated Operations Within the WFO ____ 10
The New Structure ____ 12
Staffing ____ 16

Implementation ____ 18
Transition Planning ____ 19
Demonstration and Certification ____ 20
Implementation Schedule ____ 21
Experimental Systems ____ 22

Productivity and Efficiency Advantages ____ 23

Meeting the Challenge of the 1990s ____ 24

Introduction

Weather pervades and affects the daily life of each American. Since the beginning of the Republic, a strong scientific tradition of meteorological research and service has existed in the United States. At a national, regional, and local scale, weather affects the Nation's agriculture, water resources, transportation, general economy, and public safety. Accurate information about future atmospheric events is key to mitigating any adverse effects of the weather. Federal agencies have long joined in cooperative efforts to collect, share, and effectively use weather data and information for the public good. Applied research conducted over the last ten years in the National Oceanic and Atmospheric Administration's (NOAA) Environmental Research Laboratories in New Jersey, Colorado and Oklahoma, and other Federal laboratories such as the National Center for Atmospheric Research has demonstrated that state-of-the-art laboratory techniques for analyzing and predicting severe weather and flood phenomena can be practicably applied to Weather Service operations. Because the scientific understanding of the atmosphere and the ability to forecast large and small-scale weather phenomena has increased dramatically over the last two decades, the Department of Commerce has set an ambitious goal for the National Oceanic and Atmospheric Administration's agency, the National Weather Service (NWS):

To modernize the NWS through the deployment of proven observational, information processing and communications technologies, and to establish an associated cost effective operational structure. The modernization and associated restructuring of NWS shall assure that the major advances which have been made in our ability to observe and understand the atmosphere are applied to the practical problems of providing weather and hydrologic services to the Nation.

Implementation and practice of the new science will achieve more uniform weather services across the Nation, improve forecasts, provide more reliable detection and prediction of severe weather and

flooding, permit a more cost effective NWS, and achieve higher productivity for NWS employees. The effort to improve weather warnings and forecasts will be guided by the principle of providing high quality weather services to users while concurrently lowering NWS operating costs. The development of new technologies will be guided by the principle of balancing technical and service improvements with overall costs. All changes proposed by the NWS will allow productivity and efficiency for any entity dependent on weather information. This includes local, state, and Federal government agencies, private sector meteorologists, private industry, and resource management organizations.

In 1988, Public Law 100–685 was signed by the President which, in part, specifies conditions on the planning, reporting and accomplishment of the modernization and associated restructuring of the NWS. This Strategic Plan is the first response to the Congress required by Public Law 100–685. The Federal law requires an identification of the basic service improvement objectives of the modernization, the pivotal new technological components, and the associated operational changes required to fulfill the objectives of weather and flood warning improvements. Plans, resources, schedules, etc. will be contained in the second, and subsequently annual report required by the Congress—the National Implementation Plan.

Principles for the Modernization and Associated Restructuring

The Modernization and Associated Restructuring goal will require significant changes in the current weather service infrastructure and operations. Accordingly, the following principles will guide the planning and implementation.

Throughout the process of change, the **NWS is committed to its mission** which is *to provide weather and flood warnings, public forecasts and advisories for all of the United States, its territories, adjacent waters and ocean areas, primarily for the protection of life and property. NWS data and products are provided to private meteorologists for the provision of all specialized services.* The following principles are essential to meet the operational mission and will be continued during the modernization and associated restructuring transition period.

The principle that the modernization and associated restructuring process will not result in the degradation of services to the general

public. Also, service and structural changes and improvements will be implemented only when certified in accordance with Public Law 100–685 to be beneficial to users.

The principle that NWS employees will be involved because their participation is crucial to a successful transition and improved operations. Significant levels of training and education will be provided so that employees will gain the necessary expertise to utilize the new technologies, understand the new sciences underpinning the modernization and associated restructuring and provide the improved services to the Nation. The changes will provide exciting opportunities for professional growth.

The principle that United States international meteorological and hydrologic obligations will be met during and after the modernization and associated restructuring. The exchange of global atmospheric data is essential to the successful interpretation and forecast of weather phenomena in the United States. The NWS is a partner supporting national security interests on a global basis.

The principle that NWS employees will continue to provide the quality weather services required by the country in the most economical manner.

The Need To Implement New Science and Technology

A weather service organization, whether private or public, fulfills fundamental public safety and economic needs. The information provided supports life-saving and economic productivity decisions. For example, hurricane evacuation recommendations and airline routing decisions are heavily dependent on weather forecasts. As a Nation, the United States experiences more severe local storms and flooding than any other in the world. Eighty-five percent of all presidentially declared disasters result from severe weather events. In a typical year, the United States can expect a staggering assault by the elements: some 10,000 violent thunderstorms, 5,000 floods, 1,000 tornados, and several hurricanes. Along with periods of severe drought, hard winters, and heat waves, these events translate into considerable loss of life and annual property damages estimated in billions of dollars.

The most deadly of our Nation's weather events—tornados, severe thunderstorms, and flash floods—are also the most difficult to detect

and forecast. They form and exist at the small atmospheric scale (mesoscale) and are measured in minutes and tens of miles. Most mesoscale phenomena are well below the operational resolution of routine observations and analysis today. However, prototype observing technologies and information processing systems, when made available to research meteorologists have provided the first observations of, and insights into the formative indicators of dynamic mesoscale processes of the atmosphere. When implemented operationally, these systems and associated science will improve all weather forecasts provided by national meteorological centers and weather forecast offices. These new systems will enable earlier detection and permit the short range prediction of destructive, violent, local storms and floods, thereby mitigating a glaring shortfall in current warning services. The new observational technologies planned for the next decade will provide unprecedented amounts of complex information and data, requiring significantly higher levels of analytical and interpretive skills by the operational forecasters.

To realize the gains from this research and technology, the Nation needs to put the new meteorological science into practice. This will require training personnel and the deployment of proven, new observational, information processing, and communications technologies.

At present, the vintage technologies that compose part of today's weather service infrastructure need to be replaced. As the equipment has aged, it has become costly to maintain. By replacing the equipment with more reliable technologies that support the new scientific capabilities, the Nation can move into the twenty-first century with strengthened confidence in its atmospheric prediction capabilities.

The Need To Implement New Technology

The Technological Opportunity

Major Technologies for Modernization

New technological systems are essential in providing the opportunity to improve warning and forecast services and for replacing obsolete and increasingly unreliable existing systems. Each of the new technologies plays a unique, but complementary role in the modernization process. The information provided by the new observational technologies will yield high resolution, time variant, three-dimensional representations of details on the state of the atmosphere. At Weather Forecast Offices, intended to perform warning and forecast services, advanced weather data processing systems will aid the forecaster in the assimilation of changing data and numerical weather prediction products. The meteorologist and hydrologist will be able to rapidly manipulate, display and analyze information, thus enabling them to combine scientific principles and operational experience to produce more accurate and timely warning and forecast services for the Nation. The new high-resolution data sets and derived information are an important input to business and economic decision making outside the NWS.

Numerous Federal agencies have long shared in the observation and exchange of hydrometeorological data. The existing national observing networks are sparse and limited in their coverage of the Nation's atmosphere. The NWS is joined in its acquisition of much of the major new technologies by the Department of Transportation's Federal Aviation Administration and the Department of Defense, which results in economies of scale and a reduction in purchase costs. The geographical placement of the new radars and automated surface observing systems is coordinated by the three agencies thereby providing more uniform national coverage by these land-based systems. The new geostationary meteorological satellites being procured by NOAA complement the new radars and automated surface observing systems with blanket coverage of the conterminous states. Data from these new observing systems will be shared by each participating agency and will be available in summary form throughout the Nation.

Automated Surface Observing System (ASOS)

Automating surface observations will relieve staff from the manual collection of surface observations. Over 1000 ASOS systems across the Nation will be providing data on pressure, temperature, wind direction and speed, runway visibility, cloud ceiling heights, and type and intensity of precipitation on a nearly continuous basis. The 1000 ASOS sites include approximately 750 airport installations under the jurisdiction of the Federal Aviation Administration and approximately 250 NWS sites. The Department of Defense is also considering the acquisition of additional units. The observational data provided by the ASOS system supports aviation operations and provides meteorological data needed by severe weather, flash flood, and river flood forecasting programs. The national capability to observe and transmit critical changing weather conditions almost as they occur represents an important enhancement for improving warning and forecast services.

Next Generation Weather Radars (NEXRAD)

Utilizing Doppler radar technology, the NEXRAD system will observe the presence and calculate the speed and direction of motion of severe weather elements such as tornados and violent thunderstorms. NEXRAD will also provide quantitative area precipitation measurements so important in hydrologic forecasting of potential flooding. The severe weather and motion detection capabilities offered by NEXRAD will contribute toward an increase in the accuracy and timeliness of NWS warning services. At present, for example, due to the limitation in the current radar detection systems, tornado warnings are usually issued only when visual sightings have been reported. The advent of NEXRAD will not only allow for an earlier detection of the precursors to tornadic activity, but will also provide data on the direction and speed of tornado cells once they form. The national network of 160 NEXRAD systems provides a significant improvement in uniform coverage over the present day radar network. The NWS plans to operate 121 NEXRAD systems; the remainder of the NEXRAD systems will be located at Federal Aviation Administration and Department of Defense locations.

Satellite Upgrades

For severe weather and flood warnings and short range forecasts, cloud imagery and atmospheric sounding data from the geostationary meteorological satellites will continue to be a major data source. The new Geostationary Operational Environmental Satellite (GOES)

I-M system will have separate instrumentation that allows simultaneous image and sounding data to be observed and transmitted to ground stations. The GOES I-M system will also provide visible and infrared imagery data updates as frequently as every six minutes during severe weather warning situations over selected areas of the United States.

For longer-range forecasting, soundings from the polar orbiting satellites are a primary data input into the National Meteorological Center numerical forecast models. The Advanced Microwave Sounding Unit, to be flown on the NOAA K-M satellite series, will provide global soundings in cloudy regions at nearly the same level of accuracy as those presently produced in cloud free areas.

National Center Advanced Computer Systems

Warnings and forecasts prepared by NWS offices in the next decade will rely heavily on the basic analyses and guidance products provided by the National Meteorological Center, especially for periods of 36 hours and beyond. These analyses and guidance products result from numerical models of the atmosphere run on high-speed computers. The future requirement for guidance products for mesoscale warnings and forecasts is greatly increased over the present. Fundamental model improvements are necessary to satisfy these requirements and provide guidance products of sufficient quality and frequency to support the warning and forecast operation at each office. Present day Class VI computers do not possess sufficient capacity to support the improvements needed at the National Centers. These increased demands require the acquisition of dedicated next generation Class VII computer capabilities with a processing capability an order of magnitude greater than the present Class VI computer.

Advanced Weather Interactive Processing System (AWIPS)

The revised AWIPS system will be the nerve center of the operations. AWIPS will be the data integrator receiving the high-resolution data from the observation systems, the centrally collected data and the centrally prepared analysis and guidance products from the National Meteorological Center. The integration of all of this data from multiple sources represents the information base from which all warning and forecast products will be prepared. The AWIPS system will provide fast-response interactive analysis and display of the

data to help support the meteorologist make rapid decisions, prepare warnings and forecasts, and disseminate products to users.

AWIPS includes the communications network that inter-connects each Weather Forecast Office for exchange of locally generated data. NOAAPORT will provide communications support for the operational distribution of the centrally collected data and centrally produced analysis and guidance products, as well as the satellite imagery and sounding data processed by the National Environmental Satellite, Data and Information Service. In addition to supporting the requirement for AWIPS point to multi-point communications, NOAAPORT will also deliver a wide range of NOAA products, such as oceanographic and environmental data to external users including other government agencies, universities, private research organizations, and business interests.

The Need To Restructure

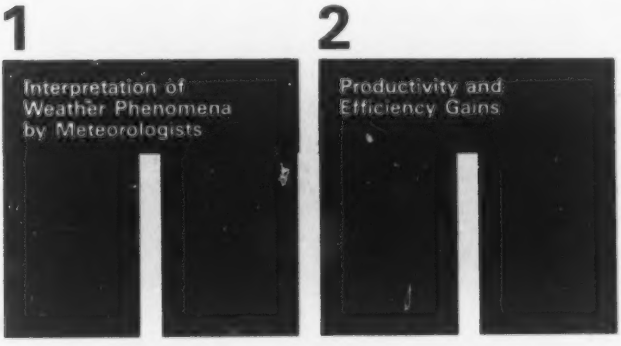
The planned restructuring involves changing the number and location of field offices in a manner responsive to certification conditions imposed by Public Law 100–685, a gradual transformation of the workforce to one more professional in its makeup, and a reallocation of operational responsibilities between field offices and the National Centers.

The effective use of the advanced technologies planned for the NWS is closely linked to the scientific abilities of NWS personnel and the national field office structure. The current field office structure has evolved intermittently throughout the agency's history. Today, the structure supports a labor intensive observation and dissemination network. If the new technological network were constrained by the current field office structure, required staffing levels and overall costs would increase unnecessarily.

The need to restructure is twofold: first, the combination of new operational concepts, new data sets, and an evolving scientific understanding of the dynamic processes associated with the most dangerous weather phenomena requires an increase in the number of meteorologists. During periods of impending severe weather and flooding, operational personnel are under extreme pressure to make timely and accurate decisions. The percentage increase of meteorologists in the NWS workforce will improve warnings and forecasts by taking advantage of the capabilities of the new technologies. Second,

productivity and efficiency gains will occur as a result of increased integration of the new technological observation, information processing and communication systems with the staff. An increased effective range of the radar systems and the ability to assemble all data at a reduced number of offices increases productivity and efficiency. The reduced number of offices places a special emphasis on the effective delivery of weather services to communities.

Key tradeoffs in the restructuring process exist between human capabilities, costs, and programmatic, scientific, and technological opportunities. Factors considered in determining restructuring and ultimately the quality of warning and forecast services include the ability to establish a more uniform observational network across the country, the automation of observational duties, orographic (effects of mountains) characteristics, the ability of the NWS workforce to employ and understand new technologies and science, and so on.



The Need To Restructure is Twofold

The National Weather Service in the 1990s

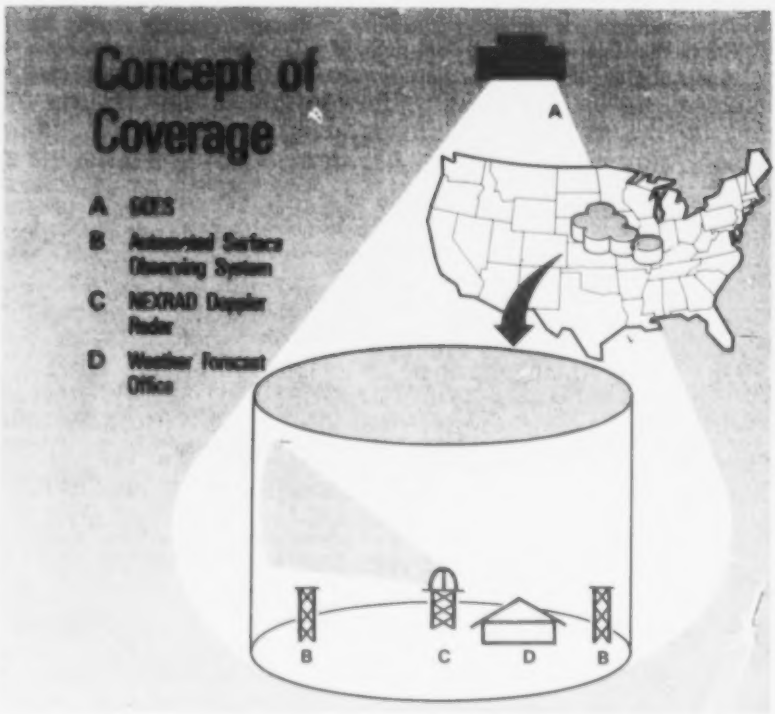
The Weather Forecast Office (WFO) Area of Responsibility

A conceptual analogy of the area of responsibility of a WFO can be portrayed as follows: on the surface of a map of the United States consider a uniform arrangement of 115 conterminous cylinders, each with a radius of approximately 125 miles, extending from the earth's surface up through the atmosphere. The volume of space contained within each cylinder represents the "area" of operational responsibility associated with the WFO. A WFO is located in the center of the base of the cylinder. Each section of the country and the coastal ocean is contained in one of these cylinders and the whole of the country is theoretically uniformly covered.

The GOES Satellite positioned over the United States is providing uniform coverage with visible and infrared imagery and remote soundings penetrating each cylinder from above. Associated with each WFO is one or more NEXRAD radars which scan the atmosphere from near the earth's surface to a height sufficient to detect the majority of meteorological events. Across the surface of the country are the approximately 1000 ASOS units each measuring surface weather parameters as fast as every minute. All of these data within the cylinder are sent directly to the AWIPS system in each WFO. The AWIPS is also receiving the centrally produced guidance products from the National Centers generated from globally exchanged data. Subsets of these data sets are available to all other WFOs through the AWIPS communication network.

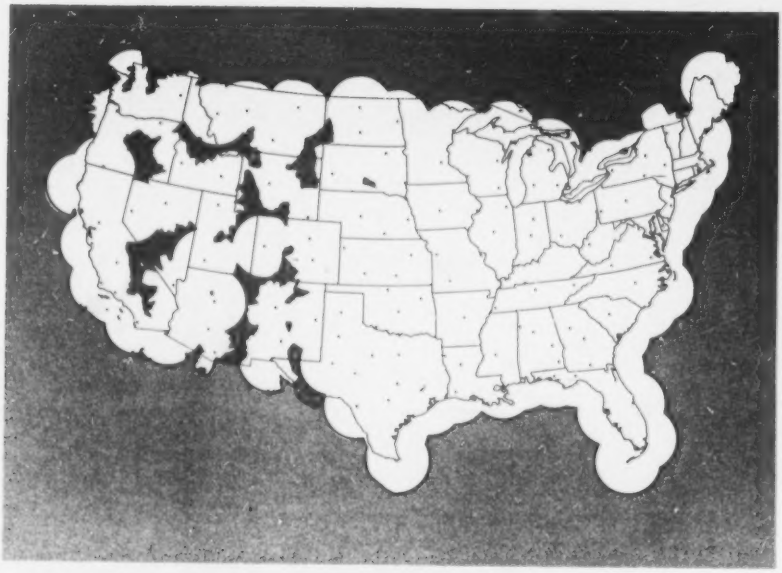
Integrated Operations Within the WFO

The future operations will allow forecasters to comprehensively address the air-sea environment in their assigned area. The observation and analysis of current and expected weather conditions can be quickly and reliably completed, critical decisions made, and translated into immediate warnings and forecasts. This is contrasted to current operations where a number of meteorologists and technicians are required to individually evaluate a limited data base and separately derive the required variety of warnings and forecasts.



The concept of the local data base is central to future operations. The high volume of data from the local NEXRAD and geostationary meteorological satellites combined with the high frequency observations from ASOS will flow directly to the Weather Forecast Office. The most complete data sets will only be available to the local WFO. However, summarized data from all NEXRADs and ASOSs in the Nation will be made available to all field offices.

The new observing systems are designed to provide data sets which can be immediately integrated into three dimensional depictions of the rapidly changing state of the environment. Each system will contribute a critical part, combining with and complementing data from all other systems to form a complete set of information

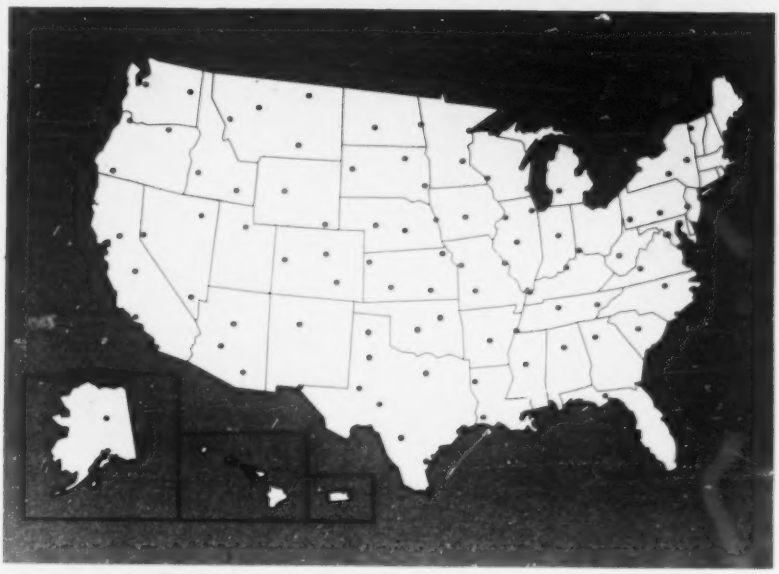


Depiction of the Total Coverage (at 10,000 Ft. Elevation) Provided by the Completed National NEXRAD Network.

about the space from the earth's surface to the upper atmosphere over the WFO's area of responsibility. AWIPS work stations will allow the forecaster to quickly update, quality control, and analyze current processes and events detailed within the area of concern. New dedicated supercomputer capabilities and high resolution models running at the National Centers will provide a stream of detailed, frequently updated guidance to forecasters, assisting in the prediction of future conditions. This represents a new, highly integrated mode of operation which greatly increases the productivity of personnel, and also holds the promise of increased accuracy and greater timeliness of forecast services for the Nation.

The New Structure

The WFO will be the future weather office that will provide all warning and forecast services for its assigned area of responsibility. The forecast and warnings operations at the WFO are supported by guidance products issued from the National Centers and RFCs.



Locations of the Weather Forecast Offices

Weather Forecast Offices (WFOs)

A total of 115 WFOs will exist in the future that will provide weather and hydrologic services in four major areas:

- Watches and warnings for the general public for severe local storms, floods, flash floods and winter storms. Local and zone public forecasts, and fire weather forecasts;
- Local aviation watches and warnings, terminal forecasts, and domestic aviation enroute forecasts;
- Marine warnings and forecasts for coastal areas of the Nation and the Great Lakes; and
- Hydrologic services which identify flash flood-prone areas and the development of community supported surveillance systems.

The foundation for the more accurate and timely warnings and forecasts will be the guidance products from the National Centers and RFCs and the data from the new observing systems: ASOS, NEXRAD, and geostationary meteorological satellites. They will provide the unique local data base which depicts the environment in the WFO's area of responsibility.

The basic tool for more accurate and timely warnings and forecasts from the WFO is AWIPS. It will assemble, process and display the observational data and guidance from National Centers. AWIPS will help meteorologists with the warning and forecast decision process through an interactive work station. It will preformat warning and forecast products and disseminate these products to the users in a timely manner.

River Forecast Centers (RFCs)

RFCs provide hydrologic forecasts and guidance information in three major categories:

- Mainstem river and flood forecasts for conditions at approximately 3000 locations with lead times ranging from six hours to several days;
- Flash flood and headwater guidance to WFOs for warning services involving small drainage basins with response times under six hours; and
- Long-term, seasonal forecasts providing estimates of snowmelt and water supply outlooks (from excess to drought) at approximately 1000 locations for periods up to several months in advance.

In the 1990s, the operations of RFCs are expected to change in a number of important ways. Each of the 13 RFCs will be colocated with a WFO. This will result in a more effective utilization of hydrological and meteorological information facilitated by a Hydrologic Analysis and Support Group in each colocated facility. It will also result in cost savings through shared facilities and through on-site exchange of data and information. Flash flood procedures will be more sophisticated resulting in more frequent updates of guidance and information for use by WFOs.

The basic river and flood forecasts produced by the RFC for specific locations along mainstem rivers are sent to WFOs as a basis for flood warnings to the public. Historically, RFCs have operated on one forecast cycle per day, based upon manual observations taken early each morning. To keep pace with changing weather and soil moisture conditions, assimilated data from automated data collection networks and NEXRAD, and to provide quality control, RFCs will operate an average of 16 hours-per-day. RFC operations will expand to 24 hours during periods of flood threat and with seasonal peak work loads. RFCs will produce hydrologic forecasts

as frequently as every six hours, based upon additional data and improved forecast procedures. AWIPS will assist hydrologists in the RFCs through data collection and processing, hydrological model execution, product formatting, and product dissemination.

National Meteorological Center

The National Meteorological Center has the responsibility for national and international data collection. This data base is first employed for global atmospheric and oceanic analysis. The resultant analysis products are distributed to international and domestic users which include the NWS, other government agencies, and private sector meteorologists. The data base is then used as initial input to global atmospheric numerical models. These models produce international aviation forecast products, high seas forecast products, long range national forecast, and forecast guidance for local WFOs and RFCs. New dedicated Class VII computer capabilities will enable increases in the resolution of the models resulting in improved forecast products and guidance. Traditionally the long range national forecasts have begun at 3–4 days and beyond. The new computers will reduce this threshold to beyond 36 hours. This will allow local forecasters to devote their attention to short-term weather events that are not amenable to centralized model solutions.

Climate Analysis Center

The Climate Analysis Center is a specialized center established in support of the National Climate Program Act. The Climate Analysis Center is part of the National Meteorological Center and is colocated with it to take advantage of the data, computers, and scientific expertise available there. The Climate Analysis Center's responsibilities are national and international in scope, related to overall goals of the United States Climate Program and are not directly affected by the NWS field reorganization. The Climate Analysis Center collects, organizes and disseminates climate information for diagnosis of short-term climate change; conducts and supports research on the physical cause of short-term (monthly, seasonal and interannual) climate change; and issues forecasts of weekly, monthly, and seasonal departures of average weather conditions from climatological means.

National Hurricane Center

The National Hurricane Center will continue to be responsible for the analysis, prediction, and tracking of tropical weather systems, their development into tropical storms and hurricanes, and larger scale disaster preparedness and coordination. Geostationary meteorological satellites will track and monitor tropical storms 24 hours-per-day throughout their entire life cycle. Coastal NEXRADs will provide the opportunity to examine tropical storms and hurricanes as they approach land, to an extent never before possible. New dedicated Class VII computer capabilities located at the National Meteorological Center will run new hurricane models which will provide improved hurricane forecast guidance to highly specialized tropical and hurricane forecasters located at the National Hurricane Center. AWIPS at the National Hurricane Center will integrate data, improve storm identification and tracking, improve dissemination of vital information to the NWS and external users, and allow more efficient use of personnel.

National Severe Storms Forecast Center

In the 1990s, the National Severe Storms Forecast Center will provide national severe weather guidance to WFOs and RFCs. It will issue more timely and specific mesoscale guidance necessary to support the severe weather and flood warning activities of the WFOs. It will develop new guidance products based upon National Meteorological Center mesoscale model output and new mesoscale data. It will continue to produce special hazardous weather forecasts and forecast guidance for domestic aviation users under interagency agreement with the Federal Aviation Administration. All of these activities depend on the new observing systems (NEXRAD, ASOS and geostationary meteorological satellites), on AWIPS, and on the improved guidance from the National Meteorological Center Class VII computer capabilities.

National Data Buoy Center

The National Data Buoy Center will continue the operation of deep sea, coastal buoys, and headland systems. Data from these buoys and these coastal systems are essential to marine warnings and forecasts, and numerical weather predictions.

Staffing

The new observing and data processing and display systems will provide forecasters the opportunity to sample, observe, and analyze the environment to an extent never before possible. The related ex-

pansion of the sciences of meteorology and hydrology will directly translate into improved service capability while simultaneously allowing greater efficiencies. Future field offices will have a core staff of professional scientists at each WFO and RFC to take advantage of these new capabilities. These individuals will be charged to provide all warning and forecast services across their area of responsibility. They will meet these tasks with the ability to evaluate vast amounts of integrated data, analyze the processes and events which will affect their area, and apply their scientific and technical expertise in a broad spectrum of immediate decisions. These will translate into a flow of service products, warnings, forecasts and advisories, that will be based on, and contain increased detail for all parts of the area.

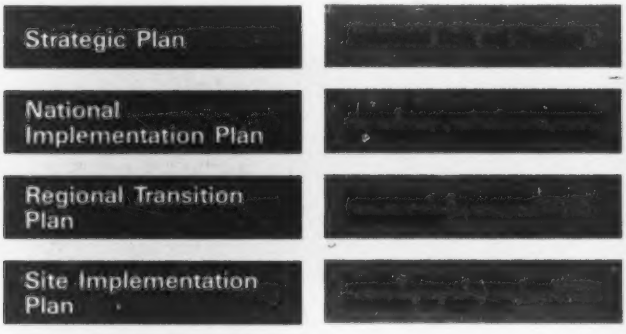
Meteorological technicians will require different skills to support the new technologies, and more demanding, and increasingly sophisticated operations. System maintenance requirements will also place increased demands on electronic technicians who will require advanced training to support and maintain a variety of complex equipment.

A Meteorologist-in-Charge will have responsibility for each WFO. WFOs will operate 24 hours-per-day. The staffing level will be determined by peak service demands and maximum weather activity, with reduced staff requirements at selected offices during hours of lower threat and service demands. The support staff in each WFO will include positions providing critical program and maintenance support to ensure efficient operations and for the practice of advanced applied science. The public hydrologic warning, forecast and information programs of each WFO will be managed and supported by Service Hydrologists strategically located at selected WFOs throughout the Nation. At each of the 13 colocated WFO/RFC facilities, a Hydrologist-in-Charge will have responsibility for the RFC, including the Hydrometeorological Analysis and Support Group. Hydrologists and hydrometeorologists will maintain non-real-time operational support functions, as well as provide hydrometeorological support to the multiple WFOs within the RFC's area of responsibility. Staffing levels at the RFCs will be sufficient to maintain forecast services, nominally 16 hours-per-day, with variations attuned to each RFC's hydro-climatology and seasonal distribution of flood threats.

Implementation

The NWS has never undertaken a systematic modernization and associated restructuring effort of the magnitude presented in this Strategic Plan. Accomplishing the transition from today's operation to the modernized and restructured NWS of the 1990s, without disrupting ongoing services, will be a complicated process. Application of the new science, enhancement of the workforce, deployment of the new technology, and restructuring of field offices will mean that virtually every NWS activity will change in some way during the next eight years.

Management of this transition will be a complex effort, involving every level of the NWS. Accordingly, the NWS has established a Transition Program Office to provide an organizational focus for the entire transition process. The Transition Program Office will draw upon the technical staff resources of the NWS Headquarters, regional offices and field stations to prepare the plans necessary for the NWS modernization and associated restructuring. Once these plans are prepared, the Transition Program Office will manage the implementation.



Implementation Planning

Transition Planning

Transition plans will be placed in a tiered structure, with the Strategic Plan as the top level plan. The second tier, the National Implementation Plan, will be a broad guidance document supported by more detailed transition planning and implementation activities carried on throughout the entire agency. The National Implementation Plan will provide a planning framework and general strategies for accomplishing the transition, and establish basic transition management principles that will be used throughout the entire transition period in fulfilling the fundamental goals and objectives in the Strategic Plan. The National Implementation Plan will be updated annually and used to provide the Executive Branch, Congress, cooperating agencies, users, and the public with an overview of what modernization and associated restructuring is, how and when NWS will accomplish the transition, and progress reports on implementation.

The third planning tier, the Regional Transition Plans, will provide management flexibility and recognize both the decentralized nature of the agency's and the NWS Regions' responsiblity to maintain ongoing operations throughout the transition period. These plans, intended for internal use, will set a course that will ultimately achieve the modernization and associated restructuring goals and objectives within each Region, while taking into account unique conditions at each site, such as weather variations and user needs. Each Regional office will have the lead responsibility for preparation of their Regional Transition Plan, consistent with national policy.

The final planning tier, Site Implementation Plans, will contain specific, detailed actions and schedules for accomplishment. A separate Site Implementation Plan will be prepared for each WFO or WFO/RFC, and will address transition of all sites in its area of responsibility. Each Regional office will be responsible for the development and integration of Site Implementation Plans, with the support of the area managers.

The changes in operations and services related to modernization and associated restructuring will ultimately guide the transition. Future operations and services define the system outputs, the staffing type and mix of an office, and the field structure needed to efficiently provide these services. These, in turn, set requirements for training and education, facility preparation, and guide a number of other dimensions of the modernization and associated restructuring. A realistic view of technological capabilities, resource availability and

schedules, and the NWS environment will help shape the scope and pace of service changes.

The breadth of future operations and services is bounded by the agency mission and scientific and technological capability. Transition planning will recognize and incorporate these factors, and retain sufficient flexibility to respond to these dynamics. The NWS will plan and maintain a steady and predictable pace for implementation to allow sufficient time for orderly change and adjustment, both internally and externally, and to accommodate and capitalize upon the new knowledge and understanding acquired throughout the transition period.

Demonstration and Certification

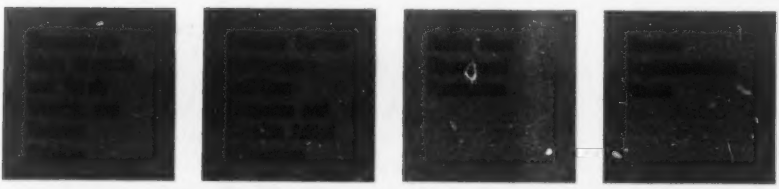
The modernization and associated restructuring of NWS features improved services through the effective and efficient use of the new technology. Aspects of this objective imply significant change both internally and externally. Active participation by NWS employees and external users is imperative for a successful transition. Support will be sought by informing them in advance of what changes are planned and why these changes are needed. Clear demonstrations of the service improvements that will result from these changes are a critical element in obtaining NWS employee and external user acceptance.

Demonstrations of new capabilities and services will take place through a wide range of activities. The Modernization and Associated Restructuring Demonstration (MARD) will be the centerpiece for demonstrating the fully modernized and restructured NWS of the 1990s. As currently planned, MARD will take place in a multi-state area in the central United States which is extremely prone to severe weather. Once the proper number and mix of staff is in place along with the new technology, and training has been completed, a number of WFOs supported by RFCs and National Centers will operate in the modernized and restructured mode as the first step towards national conversion to the new structure.

The primary objectives of MARD are to demonstrate more accurate and timely warning and forecast services and to provide an opportunity to evaluate service performance and responses of users within the context of the most cost-effective organizational structure.

MARD will help refine new operational procedures and resolve implementation issues that can best be addressed through actual field experience. MARD will also provide an opportunity to examine additional organizational efficiencies that may be gained from application of the new science and operation of the new technology, such as a 2-tier field office structure with reduced staffing at some offices.

Based upon the MARD experience, full implementation of modernized and restructured operations will proceed on a national basis in compliance with the provisions of Public Law 100–685. During national conversion to the new structure, existing weather service offices would be closed, consolidated, automated or relocated only when such action can be certified to result in no degradation of services to the affected area.



Modernization Associated Restructuring Demonstration

Implementation Schedule

Programs to acquire the new technology have been approved, and acquisition is underway. Developmental efforts to simulate the Weather Forecast Office of the 1990s have been undertaken since the late 1970s at NOAA's Environmental Research Laboratories as part of the Program for Regional Observing and Forecasting Services. Planning for application of the new science, transformation of the workforce, and the deployment of the new technology has been started. In a broad outline, the implementation schedule for modernization and associated restructuring of the NWS will consist of activities bracketed in time between now and MARD that must be accomplished in preparation for the demonstration, the Modernization and Associated Restructuring Demonstration itself, and implemen-

tation of full modernized and restructured operations after MARD. Field preparatory and risk reduction activities requiring long lead times to complete have already begun, and are scheduled to ensure their timely completion.

Experimental Systems

Additional work is underway on other technologies, though technically not now a part of the modernization program. As the research community continues development of experimental systems to improve observational techniques or improve operating efficiencies, demonstration networks may be deployed at specialized operational sites to establish and validate the utility of the new data or improved system. These centers of excellence provide unique opportunities for the research and operational communities to jointly assess and improve the operational utility of the new scientific innovations.

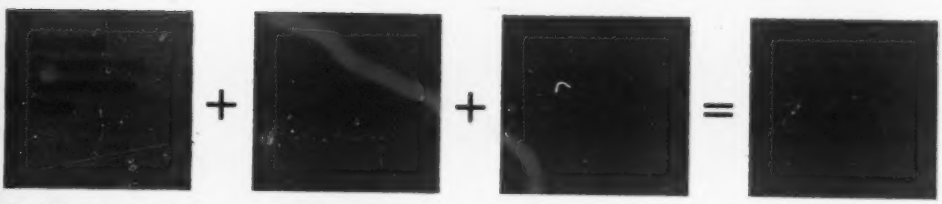
A demonstration project is underway that will deploy a new ground-based atmospheric sounding system, the wind profiler. This system will provide data on atmospheric winds with time and height resolutions not economically available with alternative techniques. Research is also continuing on thermo-dynamic profilers that may ultimately make important improvements in the acquisition of moisture and temperature information and lower the operating costs of today's upper air program.

Productivity and Efficiency Advantages

In designing the modernized and restructured NWS as a complete system, as opposed to the current system, which has evolved sporadically throughout the agency's history, improvements in services can be combined with productivity and efficiency gains by deliberate design of the new NWS.

Productivity and service improvements will be achieved by automating observation and communication duties, freeing trained professionals to concentrate on the highest operational priority—analyzing and forecasting local atmospheric events. Because the data available from the precisely organized satellite, surface observing systems, and Doppler radar networks can be processed and manipulated by tomorrow's meteorologists, more accurate and timely warnings and forecasts can be provided by fewer field offices. Using more data with fewer offices and a core of professional personnel translates into higher productivity.

The productivity gains acquired with the professional workforce, new science, and advanced technologies, in turn, mean operational efficiency gains. That is, lower costs associated with delivering more accurate and timely warning and forecast services are accomplished while concurrently increasing the benefits from more timely, pertinent information. The efficiency gains, once achieved, are a direct product of the entire operational design of the modernized structure.



Productivity and Efficiency Advantages

Meeting the Challenge of the 1990s

Understanding and predicting weather, climate and the state of the Nation's rivers has never been more important to the people of the United States and the world. Major advances in technologies, scientific understanding of the atmosphere, and in the prediction of the localized, most severe storms are within reach. While the resources to achieve the goals set forth in this Strategic Plan are significant, they pale compared to the savings of lives and property attainable through the modernization and associated restructuring of the National Weather Service. The challenge of the modernization and associated restructuring is to configure the NWS field offices, implement the new systems and networks, and professionalize the NWS workforce, without diminishing ongoing operations.

This document summarizes the opportunities and challenges that the Nation faces in modernizing and restructuring its capability to detect, understand, and predict our atmosphere. The discussion focused on the new scientific concepts that foretell significant advances in meteorology and hydrology. It considered the technology available to effect these advances and scientific concepts—automated surface observations, Doppler radars, satellites, supercomputers, and advanced information processing technology.

The people, the new technology, and the new ideas at hand combine to offer unprecedented advances in hydrometeorological prediction and in understanding climate change.